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THURMAN W DIX RESERVO..(U) CORPS OF ENGINEERS WALTHAM
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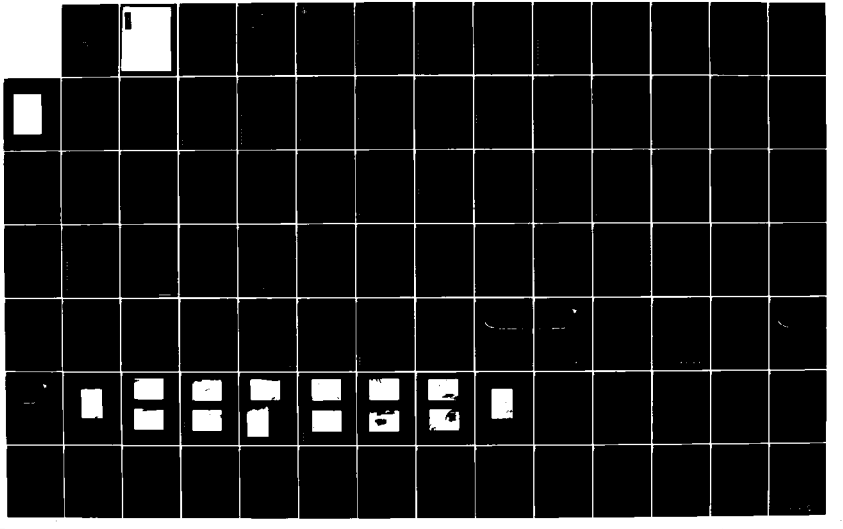

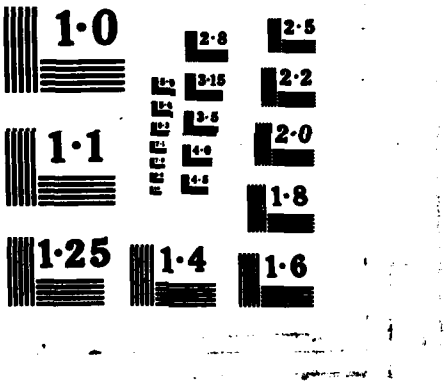
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SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

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9. PERFORMING ORGANIZATION NAME AND ADDRESS		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
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18. SUPPLEMENTARY NOTES

Cover program reads: Phase I Inspection Report, National Dam Inspection Program; however, the official title of the program is: National Program for Inspection of Non-Federal Dams; use cover date for date of report.

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

DAMS, INSPECTION, DAM SAFETY,

Richelieu River Basin
Orange VT.
Orange Brook

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The dam is about 950 ft. long and has a structural height of 50 ft. It is intermediate in size with a low hazard classification. The test flood for the dam is ½ the PMF. The dam is judged to be in good condition. Between the training walls and the bridge abutment the concrete is spalled exposing the reinforcing. There are various recommendations which should be implemented by the owner.

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DEPARTMENT OF THE ARMY
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REPLY TO
ATTENTION OF:

NEDED

APR 18 1979

Honorable Richard A. Snelling
Governor of the State of Vermont
State Capitol
Montpelier, Vermont 05602

Dear Governor Snelling:

I am forwarding to you a copy of the Thurman W. Dix Reservior Phase I Inspection Report, which was prepared under the National Program for Inspection of Non-Federal Dams. This report is presented for your use and is based upon a visual inspection, a review of the past performance and a brief hydrological study of the dam. A brief assessment is included at the beginning of the report. I have approved the report and support the findings and recommendations described in Section 7 and ask that you keep me informed of the actions taken to implement them. This follow-up action is a vitally important part of this program.

A copy of this report has been forwarded to the Department of Water Resources, the cooperating agency for the State of Vermont. In addition, a copy of the report has also been furnished the owner, City of Barre, Office of the City Manager, City Hall, Barre, Vermont 05614.

Copies of this report will be made available to the public, upon request, by this office under the Freedom of Information Act. In the case of this report the release date will be thirty days from the date of this letter.

I wish to take this opportunity to thank you and the Department of Water Resources for your cooperation in carrying out this program.

Sincerely yours,

JOHN P. CHANDLER
Colonel, Corps of Engineers
Division Engineer

Incl
As stated

THURMAN W. DIX RESERVOIR
VT00069

ORANGE, VERMONT

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

NATIONAL DAM INSPECTION PROGRAM
PHASE I INSPECTION REPORT

Identification No.: VT00069
Name of Dam: Thurman W. Dix Reservoir
Town: Orange
County and State: Orange County, Vermont
Stream: Orange Brook
Date of Inspection: July 31, 1978

BRIEF ASSESSMENT

This dam has previously been referred to as Lords Mill Dam, the Upper Orange Reservoir, and most recently the Thurman W. Dix Reservoir. The City of Barre, owner of the facility, dedicated and renamed the reservoir in honor of the late City Engineer, Thurman W. Dix. The reservoir serves as a water supply impoundment for the City of Barre and is located in the Town of Orange.

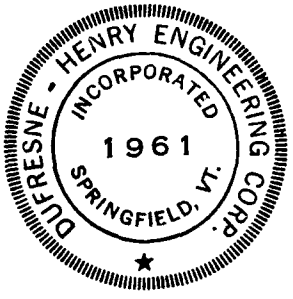
The dam is approximately 950 feet long and has a structural height of 50 feet. Near the left abutment is a concrete ogee spillway 77 feet wide with a crest elevation 10 feet below the crest of the dam. Flashboards are used to increase the spillway crest by three feet. The ogee spillway drops 35 to 40 feet in a concrete lined channel where it tapers to form a bridge abutment.

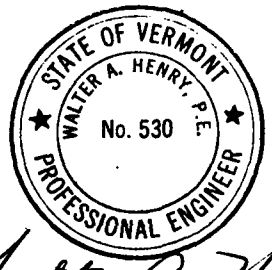
The size classification of the dam is "intermediate". The drainage area is 9.1 square miles. The impoundment storage volume is estimated to be 1070 acre-feet with a surface area of 121 acres.

The hazard classification of this dam is judged to be "low" based on the fact that no homes are located in the immediate vicinity of the downstream channel. Based on the size and hazard classification in accordance with "Recommended Guidelines for Safety Inspection of Dams, Department of the Army, November 1976" the test flood is the 1/2 Probable Maximum Flood, (PMF). The 1/2 PMF will overtop the dam by 0.9 feet without the flashboards in place, and by 1.6 feet with the flashboards in place.

The dam is judged to be in good condition. Between the training walls and the bridge abutment the concrete is spalled exposing the reinforcing.

It is recommended that the spalled areas of concrete be repaired to prevent further deterioration of concrete and reinforcement within four years of receipt of this report. The flashboards on the spillway should be eliminated or designed to fail under flood conditions. This recommendation should be implemented within one year of receipt of this report. It is further recommended that the owner continue the maintenance of the slopes to insure the proper vegetative growth and that the owner perform periodic maintenance and technical inspections of the dam. Refer to Section 7 for detailed dam assessment and recommendations.





Walter A. Henry

This Phase I Inspection Report on Thurman W. Dix Reservoir Dam has been reviewed by the undersigned Review Board members. In our opinion, the reported findings, conclusions, and recommendations are consistent with the Recommended Guidelines for Safety Inspection of Dams, and with good engineering judgment and practice, and is hereby submitted for approval.

Charles G. Tiersch

CHARLES G. TIERSCH, Chairman
Chief, Foundation and Materials Branch
Engineering Division

Fred J. Ravens Jr.

FRED J. RAVENS, Jr., Member
Chief, Design Branch
Engineering Division

Saul Cooper

SAUL COOPER, Member
Chief, Water Control Branch
Engineering Division

APPROVAL RECOMMENDED:

Joe B. Fryar

JOE B. FRYAR
Chief, Engineering Division

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines the Spillway Test Flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. Because of the magnitude and rarity of such a storm event, a finding that a spillway will not pass the test flood should not be interpreted as necessarily posing a highly inadequate condition. The test flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

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SECTION 5: HYDRAULIC AND HYDROLOGIC EVALUATION

5.1 Evaluation of Features

a. Design Data

There are no design data available for reviewing the hydraulic characteristics of the structures at the Thurman W. Dix Reservoir. Plans were available and were used in determining the hydraulic aspects of the spillway.

b. Experience Data

There are no records nor recollections of flooding at the dam site.

c. Visual Inspection

At the time of the investigation only one of four outlet gates could be operated. This gate would only allow a 10-foot drawdown below the spillway crest, under ideal conditions. In the event of a major structural defect ever arising in the dam, a significant amount of time would be lost in attempting to open the other two gates. These other two gates could not in any circumstances be opened during a flood event as the operator would not be able to access the control structures. The supports for the flash boards do not appear to be designed to break away during high flows. It also appears that it would not be possible for an operator to manually remove the flash boards during high flows.

d. Overtopping Potential

Preliminary computations assessing the adequacy of the spillway capacity indicate that the dam could be overtopped by the test flood. Analysis of the flood event with the aid of the HEC-1 computer program indicates a peak outflow from the reservoir of 9330 cfs (1025 csm) during the test flood, if no flash boards were in place. This corresponds to a water surface elevation of 1290.9 feet above mean sea level. If all three flash boards are in place, the peak discharge from the reservoir would be 10106 cfs (1110 csm) during the test flood. This would correspond to a water surface elevation of 1291.4 feet above mean sea level. In either case, the dam would be overtopped. In the case where no flash boards were in place, the surcharge on the dam would be approximately 0.9 feet. With three flash boards in place, the surcharge would be approximately 1.6 feet. The actual surcharges could possibly be lower with better data of storage and surface area.

SECTION 4: OPERATIONAL PROCEDURES

4.1 Procedures

There are flashboards, 3 feet high, on the spillway crest which are removed prior to winter and replaced during the spring of the year.

4.2 Maintenance of Dam

The grass and brush have been cut on a yearly basis and the facility is inspected regularly.

4.3 Maintenance of Operating Facilities

There are four outlets on the dam. One is gated with stop boards. The others have gates. The outlet near the left training wall is gated, and is hand wheel operated. This gate and mechanism is the only one that is relatively accessible to receive maintenance. The gate appeared to be in good operating condition.

4.4 Description of Any Warning System in Effect

There is no warning system associated with this facility.

4.5 Evaluation

Maintenance and operational procedures appear to be adequate to keep the dam and appurtenances in good operating condition.

e. Downstream Channel

The downstream channel is in fair to poor condition due to the heavy growth of brush along the overbanks, and the numerous trees within the channel. Large glacially derived boulders are abundant in the channel and range in size from 5 to 10 feet in diameter. An old stone mill dam, now abandoned, is located approximately 150 feet downstream from the bridge. The dam is approximately 6 feet high and has been breached in numerous places.

Between the Thurman W. Dix Reservoir and Jail Brook, approximately 4.5 miles downstream, only two homes exist which would be in any danger of flooding. These two homes are located within a few hundred feet of the base of the dam. They are, however, located on high ground. Because of this and the configuration of the dam, it is questionable as to whether or not they would be affected by dam failure. In the event of a major flooding event the bridge could wash out. As this road is the only access to these homes, the occupants would be isolated.

3.2 Evaluation

Based on visual examination, the embankment and appurtenant structures are in good condition. However, the concrete deterioration in the training walls and spillways if remain unchecked in the future could endanger the structure. Continuing maintenance and periodic inspections are necessary to insure a timely discovery of any future potential problems.

At the right abutment of the dam the natural ground surfaces appear to slope away from the dam and may provide an outlet around the dam. Without a field survey it is difficult to evaluate. In the event that flow could occur around the end of the dam, the two homes in the vicinity could possibly sustain more damage than if overtopping of the dam occurred.

c. Appurtenant Structures

There are two concrete retaining walls parallel to the axis of the dam at the spillway entrance. The left retaining wall, (see Photos #4 and #5) has a vertical crack with an observed maximum shear displacement across the crack of about 1-1/2 inch near the reservoir level with practically zero displacement at the top. It is thus possible that the displacement could be larger below the water level. At the crest of the dam there is a very slight settlement of the ground surfaces near the crack.

The spillway is in good condition. As seen in photograph #6, there are several holes which enter into the spillway structure near the joints a maximum of 6 inches. The concrete near the toe of the spillway has eroded to some degree to expose the aggregate.

The concrete spillway training walls show numerous areas with efflorescence and also some spalling and exposed reinforcement on the left wall immediately upstream of the road bridge. In the area of spalling, there is a seep squirting out of the wall a few inches above the bottom (see Photos #8, #9, #10).

The channel which leads from the low level outlet has reinforcing exposed on the right side. It appears that it was not embedded in concrete at the time of construction (see Photo #7).

The bottom of the discharge channel is in good condition with only a slight undercutting at the downstream end of the pavement. The natural river channel is strewn with boulders, and there are numerous tree branches overhanging the channel (see Photo #14).

d. Reservoir Area

The reservoir area is 121 acres at normal pool level. It appears that the surface area of the pond would increase with increasing elevation; however, better mapping was unavailable and any attempt to determine the change in area was unwarranted for this report.

SECTION 3: VISUAL INSPECTION

3.1 Findings

a. General

This dam is in good condition.

b. Dam

At the time of inspection, the water level in the reservoir was approximately 8 feet below the crest of the dam. The exposed part of the upstream slope is covered with riprap except for the upper 2 feet which is grass covered (see Photo #2). The exposed riprap protection is in good condition. At the crest of the dam there are occasional large boulders next to the upstream slope resulting in some relatively large voids (see Photo #13).

The crest of the dam is grass covered with no indications of erosion gullies or cracks.

The downstream slope and toe is covered with grasses up to about 3 feet high. There are no evidences of trespassing or erosion. The surface of the slope appears dry with no evidence of seepage observed on the slope or along the downstream toe. There is surface water flowing along the toe of a cut made for the road starting at about 100 feet left of the spillway channel and flowing toward the channel. As the road approaches the spillway channel, the edge of the road is close to the toe of the downstream slope of the dam, and thus the surface water flowing into the channel flows along the downstream toe of the dam. It cannot be ascertained whether there is any seepage out of the toe of the dam contributing to the observed flow.

There are two manholes downstream of the dam to the left and right of the spillway, which appear to be connected to a toe drain even though such a drain is not shown in the available design information. In the manhole to the left of the spillway channel, water was observed flowing out an 8-inch pipe. About 150 feet to the right of the spillway, one can observe an inclined stone face at the downstream toe, steeper than the slope, which could be a part of a toe drain.

Photo #3 shows a general view of the downstream slope of the dam. The trees that can be observed in some photos in several areas along the dam are growing between the downstream toe of the dam and the road and not on the dam.

SECTION 2: ENGINEERING DATA

2.1 Design

The design computations for the dam and embankment and hydrological computations for the spillway design are not available.

Plans are available for the embankment sections and there are details and plans of the spillway.

2.2 Construction

There are no records available which reflect the history of the dam during the construction phase. As-built plans are not known to exist.

2.3 Operation

The Thurman W. Dix Reservoir is a water supply reservoir operated by the City of Barre; operation of the facility is on a schedule of inspection and the flashboards are removed prior to the onset of winter and replaced in the spring.

2.4 Evaluation

a. Availability

The original design plans for the embankment and spillway are available at the Barre City Manager's Office, City Hall, Barre, Vermont.

b. Adequacy

The lack of engineering data for the dam design, spillway hydrological computations and as-built drawings does not allow for an in-depth design analysis of this facility. There is, however, sufficient data for a Phase I inspection.

The structural and hydraulic aspects of this facility cannot be assessed from a review of design calculations but must be based primarily on the visual inspection, the performance history and hydrological and hydraulic analyses of the facility as it exists today.

c. Validity

The available engineering data are considered valid on the basis of the results of the visual inspection.

Approximately 35 feet downstream from the base of the weir, a small town road bridge crosses over the spillway. During high flows this bridge would probably be washed away, however, it would not interfere with discharge from the dam.

After exiting the flume, the flow enters the natural channel of Orange Brook. The channel condition is fair to poor due to the heavy growth of brush on the banks and trees which have fallen into the channel. Glacially derived boulders litter the stream channel and range in size from 5 feet to 10 feet in diameter. Approximately 150 feet downstream of the bridge an abandoned old stone dam still exists in the channel. This dam is approximately 6 feet high and has been breached in several spots.

j. Regulating Structures

Four regulating outlets can be seen on the face of the overflow weir. Only one of these can be operated without crossing onto the weir. The two outlets that would have to be operated from the weir have never been used. Neither the City Engineer nor anyone else is, to his knowledge, acquainted with the operation or reliability of these outlets. Consequently, they should be assumed to be nonfunctional. There is also a 2.5' x 4' opening at the crest of the dam which controls flow with stop boards.

The operable regulating structure consists of a 4-foot by 4-foot box conduit located in the upper left of the spillway. The conduit can be regulated by means of a screw driven mechanism on top of the dam. On the day of the inspection the mechanism appeared to be in good condition and operable. The entrance invert elevation to the conduit is at elevation 1270 feet above MSL.

The water surface elevation of the reservoir may also be regulated by flash boards placed along the spillway crest. The flash boards are one foot high each, and can increase the spillway crest elevation by a maximum of three feet. On the day of the inspection, there were two feet of flash boards in place.

g. Dam

(1) Type

Based on the design plans the embankment is earth fill with an impervious core.

(2) Length

The overall length is approximately 950 feet.

(3) Height

The maximum height at the centerline of stream is approximately 50 feet.

(4) Top Width

The top width is 20 feet.

(5) Side Slopes

Upstream: 2-1/2H:1V
Downstream: 2H:1V

(6) Zoning

Available drawings indicate that zoning does exist.

(7) Impervious Core

An impervious earth core is indicated on the design plans.

(8) Cutoff

None known.

(9) Grout Curtain

None known.

(10) Other

The entire upstream face of the dam is riprapped.

i. Spillway

The spillway is an open concrete flume, located near the left abutment. The overflow weir is 77 feet in length with a vertical upstream face and a steeply sloping downstream face. The weir crest is 10 feet wide and located at an elevation of 1280 feet above MSL. The base of the weir is located at elevation 1245 feet above MSL on the downstream side.

b. Discharge at the Dam Site

(1) Outlet Works

A total of four outlets can be seen on the face of the dam. Two of these outlets require that the operator walk across the top of the spillway crest to open the gates. This would not be possible during a flooding situation. There is a section through the dam at the crest 2.5 feet deep and 4 feet wide. Stop boards are used to control flow through this section. The remaining outlet is a 4-foot x 4-foot box conduit and is gated with a wheel operation. The invert of this outlet is approximately 10 feet below top of spillway crest.

(2) Maximum Known Flood at Dam Site

There are no records of any flooding having occurred at the Thurman W. Dix Reservoir since it was built in 1950.

(3) Spillway Capacity

At top of dam (approximately 1290 feet MSL) the spillway capacity is 6430 cfs.

c. Elevation Data	Elevation (feet above MSL
Top of Dam (Maximum)	1290.5
Top of Dam (Minimum	1289.8
Spillway with all Flashboards in Place	1283
Spillway Crest	1280
Normal Pool	1280
Upstream Invert of 4' x 4' Box Culvert	1270
Streambed at Centerline of Dam	1240

d. Reservoir	Feet
Length of Test Flood Pool	7920+
Length of Normal Pool	7920

e. Storage Data	Acre-Feet
Top of Dam	2280+
Test Flood Pool	2280+
Normal Pool	1070

f. Reservoir Surface Area	Acres
Top of Dam	121+
Maximum Pool	121+
Normal Pool	121

h. Design and Construction History

The Thurman W. Dix Reservoir was designed by the Barre City Engineer, Thurman W. Dix, around 1950 and has since been dedicated and renamed in his memory. Previous names by which the old impoundment was known are Lords Mill Dam and Upper Orange Reservoir. The dam as it exists today was constructed in 1950 (see Photo #1).

It is an earth fill structure with an impervious core. The spillway is of concrete construction and concrete cutoff walls enter into the center of the embankment 23 feet each side of the spillway.

Flashboards were designed in 1967 and added in 1968 to increase the storage capacity of the reservoir; three 12-inch boards comprise the flashboards.

There are no records available that detail the actual day to day construction of the dam.

i. Normal Operating Procedures

The flashboards are removed prior to the onset of winter. The 4 x 4 gate is opened periodically to check operation.

1.3 Pertinent Data

a. Drainage Area

The total drainage area above the Thurman W. Dix Reservoir is 9.1 square miles.[1] The drainage area is located in the central region of the physiographic region known as the Vermont Piedmont. This is a region which is characterized by low rolling hills, with a few prominent monadnocks. The Knox Mountains (maximum elevation 3062 feet MSL) and Butterfield Mountain (maximum elevation 3166 feet MSL) are the only locations within the drainage area that can be considered as mountainous. The remainder of the topography consists of low rolling hills.

The Thurman W. Dix Reservoir is fed by three streams: Orange Brook, Nelson Brook and Nate Smith Brook. Nelson Brook and Nate Smith Brook are the major sources of water to the reservoir. They drain Butterfield Mountain and the Knox Mountains respectively. This results in a general east-west orientation of the drainage basin.

Soils within the drainage basin belong to the Berkshire-Lyman-Peru Association. These are soils formed in acid glacial till. Typically, these soils are shallow to bedrock and stony in character. As a hydrologic group they can be classed as a C+/B-.

[1]Planimetered from USGS 15-minute East Barre, Vt. Quadrangle.

The upstream and downstream slopes are 2.0H:1V. Near the left dam abutment is a concrete ogee spillway 77 feet long which has a crest elevation 10 feet below the top of the dam and drops 35 to 40 feet in a concrete lined channel where it tapers down to form a bridge abutment.

There are four gated openings in the spillway which exit at various elevations on the downstream face of the ogee spillway (see Photo #6).

c. Size Classification

The Thurman W. Dix Reservoir is a 121-acre impoundment. The dam has a potential maximum storage volume of 2280 acre-feet and a height of 50 feet. The Army Corps of Engineers recommends that dams with a storage volume of greater than 1000 acre-feet but less than 50,000 acre-feet or a height of greater than 40 feet but less than 100 feet be classified as intermediate in size. In the case of this dam both the height and storage volume criteria govern and the dam is classified as intermediate in size.

d. Hazard Classification

The potential for hazard in the event of the failure of this dam is low. There are two homes near the dam and Orange Brook but they are located on a bluff approximately twenty feet above the stream bed. Further downstream there are no dwellings that would be affected. The Village of East Barre which lies approximately three miles from the Reservoir is protected by the East Barre Dam, a flood control facility, which is located on Jail Brook approximately one half mile upstream of the Village.

e. Ownership

The Thurman W. Dix Reservoir is owned and operated by the City of Barre.

f. Operation

The Barre City Manager is the individual responsible for the daily operation of the Thurman W. Dix Reservoir. He may be contacted at the City Manager's Office, City Hall, Barre, Vermont 05641. Telephone number 802-476-6502.

g. Purpose

The Reservoir provides a water supply for the City of Barre.

NATIONAL DAM INSPECTION PROGRAM
PHASE I INSPECTION REPORT
NAME OF DAM: THURMAN W. DIX RESERVOIR

SECTION 1 - PROJECT INFORMATION

1.1 General

a. Authority

Public Law 92-367, August 8, 1972, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a National Program of Dam Inspection throughout the United States. The New England Division of the Corps of Engineers has been assigned the responsibility of supervising the inspection of dams within the New England Region. Dufresne-Henry Engineering Corporation has been retained by the New England Division to inspect and report on selected dams in the State of Vermont. Authorization and notice to proceed were issued to Dufresne-Henry Engineering Corporation under a letter of May 26, 1978 from Ralph T. Garver, Colonel, Corps of Engineers. Contract No. DACW33-78-C-0341 has been assigned by the Corps of Engineers for this work.

b. *Purpose*

1. Perform technical inspection and evaluation of non-Federal dams to identify conditions which threaten the public safety and thus permit correction in a timely manner by non-Federal interests.

2. Encourage and prepare the states to initiate quickly effective dam safety programs for non-Federal dams.

3. To update, verify and complete the National Inventory of Dams.

1.2 Description of Project

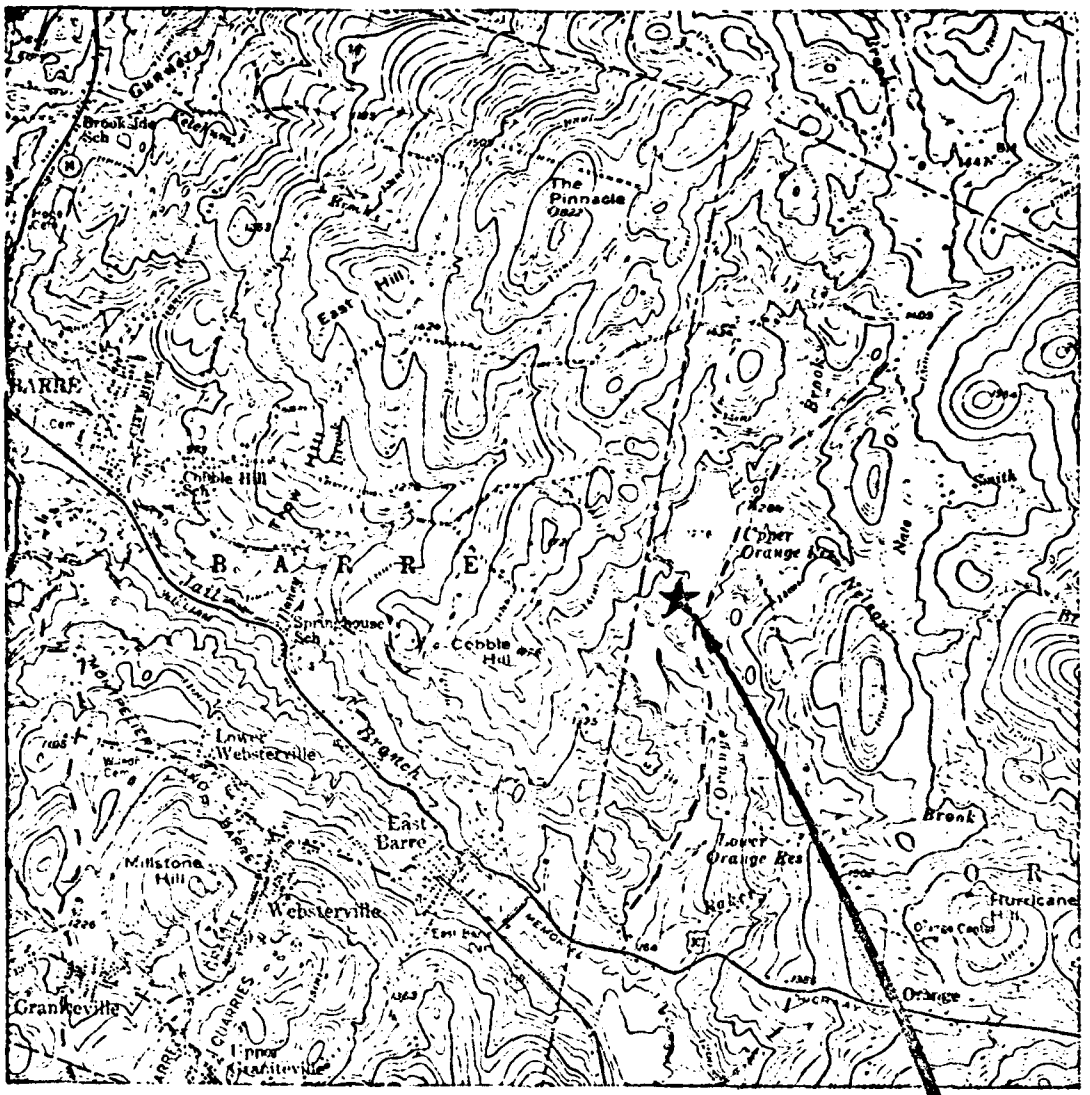
a. Location

The Thurman W. Dix Reservoir is located in the Town of Orange, Orange County, which lies in the east central section of Vermont.

This dam is situated on Orange Brook, approximately 2.25 miles from where it converges with Jail Brook and lies in the Richelieu River Basin.

b. Description of Dam and Appurtenances

The embankment is approximately 950 feet long and has a structural height 50 feet above the centerline of the stream bed.



MAP SOURCE:

U.S. GEOLOGICAL SURVEY
EAST BARRE QUADRANGLE
VERMONT
15 MIN SERIES
1:62500 1957

CLIENT NO	22-0559	DUFRESNE-HENRY ENGINEERING CORP.	
PROJ ENG	MRP	LOCATION MAP	
DRAWN BY	RB	THURMAN W DIX RESERVOIR	
DATE	9-6-78	ORANGE VERMONT	A 6012

THURMAN W. DIX RESERVOIR DAM

ORANGE, VERMONT

Analysis of a flood wave generated by a dam burst is based on engineering judgment. Because of the configuration of the dam, the most probable location for a failure to occur would be in the general area of the spillway. Here the dam is the highest and the forces acting on the dam the greatest. Assuming a flood wave of two-thirds the height of the dam, a wave 33 feet high would be produced. It is doubtful that the two houses just downstream of the dam would be affected. They would, however, be isolated for some time as the only road into these homes would be severed by the dam failure. The only area that might be adversely influenced would be the lower reservoir, approximately 1-1/2 miles downstream.

SECTION 6: STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

a. Visual Observations

The visual inspection did not disclose any apparent stability problems.

b. Design and Construction Data

There is not enough information available to perform a formal stability analysis.

c. Operation Records

The available operating records do not contain indications of instability.

d. Post-Construction Changes

The available records indicate that the only change after the 1958 construction was the installation of 3 feet of flashboards on or about 1968. The visual inspection indicates that the increase in the normal reservoir level had no significant effect on the stability of the dam.

e. Seismic Stability

Thurman W. Dix Dam is located in Seismic Zone 2 and in accordance with recommended Phase I guidelines does not warrant seismic analysis.

SECTION 7: ASSESSMENT, RECOMMENDATIONS AND REMEDIAL MEASURES

7.1 Dam Assessment

a. Condition

The visual inspection indicates that the dam is in good condition. The major concerns that may affect the long term integrity of the dam are:

1. Deterioration of the concrete on the spillway and training walls.

2. The potential for overtopping particularly with the flashboards presently on the spillway.

b. Adequacy of Information

The information available is such that an assessment of the safety of the dam must be based principally on visual inspection and past performance of the structure.

c. Urgency

Recommendations and remedial measures should take place within 1 to 4 years as stated in Section 7.2 and Section 7.3.

Continuing maintenance and periodic inspections are necessary to ensure the future safety of the dam as recommended in Section 7.2.

d. Need for Additional Investigation

Further investigations of this dam and appurtenances are not necessary.

7.2 Recommendations

a. The small holes in the ogee spillway should be repaired.

b. The areas of the spillway walls where concrete has spalled should be repaired within four years of the Phase I Inspection Report to prevent further deterioration of the concrete and steel reinforcement.

c. Redesign the flahsboards to fail when the reservoir level exceeds 1286, within one year of the receipt of the Phase I Inspection Report.

d. Survey the right abutment area to determine if areas lower than the dam crest exist. If so, these areas should be raised to the level of the crest.

7.3 Remedial Measures

a. Alternatives

The alternative to recommendation 7.2.c is to remove the flashboards.

b. Operation and Maintenance Procedures

The current maintenance program should be continued and modified to include:

1. An annual maintenance inspection including operation of the gates to insure that they function properly.

2. A biannual technical inspection.

APPENDIX A

Visual Inspection Check List

VISUAL INSPECTION CHECK LIST
PARTY ORGANIZATION

PROJECT THURMAN W. DIX RESERVOIR DATE July 31, 1978

TIME _____

WEATHER _____

W.S. ELEV. _____ U.S. ____ DN.S.

PARTY:

1. W. A. Henry	D-H	6.	
2. M. R. Peloso	D-H	7.	
3. E. J. Slavin	D-H	8.	
4. G. Castro	GEI	9.	
5.		10.	

PROJECT FEATURE	INSPECTED BY	REMARKS
1.		
2.		
3.		
4.		
5.		
6.		
7.		
8.		
9.		
10.		

PERIODIC INSPECTION CHECK LIST

PROJECT THURMAN DIX RESERVOIR DATE July 31, 1978

PROJECT FEATURE Zoned Earth Dam Embankment NAME G. Castro

DISCIPLINE Geotechnical NAME

AREA EVALUATED	CONDITION
DAM EMBANKMENT	
Crest Elevation	1280 MSL
Current Pool Elevation	1280 MSL
Maximum Impoundment to Date	Not known.
Surface Cracks	None observed.
Pavement Condition	No pavement.
Movement or Settlement of Crest	None apparent.
Lateral Movement	None apparent.
Vertical Alignment	No observable misalignment.
Horizontal Alignment	No observable misalignment.
Condition at Abutment and at Concrete Structures	Good.
Indications of Movement of Structural Items on Slopes	None.
Trespassing on Slopes	No trespassing effects.
Sloughing or Erosion of Slopes or Abutments	None observed.
Rock Slope Protection - Riprap Failures	None observed.
Unusual Movement or Cracking at or near Toes	None observed.
Unusual Embankment or Downstream Seepage	None observed. Some seepage at toe of natural slope along the road of dam and right of spillway channel.
Piping or Boils	None observed.
Foundation Drainage Features	None known or observed.
Toe Drains	None shown in available drawings but manholes observed in the field which may be for the toe drains.
Instrumentation Systems	None observed.

PERIODIC INSPECTION CHECK LIST

PROJECT THURMAN DIX RESERVOIR DATE July 31, 1978

PROJECT FEATURE NAME G. Castro

DISCIPLINE Geotechnical NAME

AREA EVALUATED	CONDITION
DIKE EMBANKMENT	No dikes.
Crest Elevation	
Current Pool Elevation	
Maximum Impoundment to Date	
Surface Cracks	
Pavement Condition	
Movement or Settlement of Crest	
Lateral Movement	
Vertical Alignment	
Horizontal Alignment	
Condition at Abutment and at Concrete Structures	
Indications of Movement of Structural Items on Slopes	
Trespassing on Slopes	
Sloughing or Erosion of Slopes or Abutments	
Rock Slope Protection - Riprap Failures	
Unusual Movement or Cracking at or near Toes	
Unusual Embankment or Downstream Seepage	
Piping or Boils	
Foundation Drainage Features	
Toe Drains	
Instrumentation System	

PERIODIC INSPECTION CHECK LIST

PROJECT THURMAN DIX RESERVOIR DATE July 31, 1978

PROJECT FEATURE _____ NAME _____

DISCIPLINE Geotechnical NAME _____

AREA EVALUATED	CONDITION
OUTLET WORKS - INTAKE CHANNEL AND INTAKE STRUCTURE	
a. Approach Channel	
Slope Conditions	Submerged - unobservable
Bottom Conditions	Submerged - unobservable
Rock Slides or Falls	None.
Log Boom	None.
Debris	None.
Condition of Concrete Lining	Unobservable.
Drains or Weep Holes	None observed.
b. Intake Structure	
Condition of Concrete	Good
Stop Logs and Slots	Good Condition, 4" x 12" boards.
	NOTE: On the day of inspection the spillway had stop boards two feet high. An outlet at the top of the dam right abutment has stop boards 48" long x 30" high. The gated outlet at the left abutment appears in good condition.

PERIODIC INSPECTION CHECK LIST

PROJECT THURMAN DIX RESERVOIR DATE July 31, 1978

PROJECT FEATURE _____ NAME _____

DISCIPLINE Geotechnical NAME _____

AREA EVALUATED	CONDITION
OUTLET WORKS - CONTROL TOWER	
a. Concrete and Structural	
General Condition	Good.
Condition of Joints	Good.
Spalling	None.
Visible Reinforcing	None observed.
Rusting or Staining of Concrete	None
Any Seepage or Efflorescence	
Joint Alignment	Good.
Unusual Seepage or Leaks in Gate Chamber	Not determinable.
Cracks	Left spillway abutment wall has large crack, some surface cracks and efflorescence
Rusting or Corrosion of Steel	
b. Mechanical and Electrical	
Air Vents	None.
Float Wells	None.
Crane Hoist	None.
Elevator	None.
Hydraulic System	None.
Service Gates	Good.
Emergency Gates	Good.
Lightning Protection System	None.
Emergency Power System	None.
Wiring and Lighting System	None.

PERIODIC INSPECTION CHECK LIST

PROJECT THURMAN DIX RESERVOIR DATE July 31, 1978

PROJECT FEATURE _____ NAME _____

DISCIPLINE Geotechnical NAME _____

AREA EVALUATED	CONDITION
OUTLET WORKS - TRANSITION AND CONDUIT	
General Condition of Concrete	Good.
Rust or Staining on Concrete	Unobservable.
Spalling	Unobservable.
Erosion or Cavitation	None observed.
Cracking	None observed.
Alignment of Monoliths	Good.
Alignment of Joints	Good.
Numbering of Monoliths	Not applicable.

PERIODIC INSPECTION CHECK LIST

PROJECT THURMAN DIX RESERVOIR **DATE** July 31, 1978

PROJECT FEATURE _____ **NAME** _____

DISCIPLINE Geotechnical **NAME** _____

AREA EVALUATED	CONDITION
OUTLET WORKS - OUTLET STRUCTURE AND OUTLET CHANNEL	
General Condition of Concrete	Fair.
Rust or Staining	Yes.
Spalling	Yes.
Erosion or Cavitation	Minor erosion of concrete.
Visible Reinforcing	Yes, on left training wall.
Any Seepage or Efflorescence	Yes, throughout structure in varying degrees.
Condition at Joints	Good.
Drain Holes	None observed.
Channel	
Loose Rock or Trees Overhanging Channel	No rocks. Some trees overhanging.
Condition of Discharge Channel	Poor.

PERIODIC INSPECTION CHECK LIST

PROJECT THURMAN DIX RESERVOIR DATE July 31, 1978

PROJECT FEATURE NAME G. Castro

DISCIPLINE Geotechnical NAME

AREA EVALUATED	CONDITION
OUTLET WORKS - SPILLWAY WEIR, APPROACH AND DISCHARGE CHANNELS	
a. Approach Channel	
General Condition	Unobservable.
Loose Rock Overhanging Channel	None.
Trees Overhanging Channel	None.
Floor of Approach Channel	Unobservable.
b. Weir and Training or Sidewalls	
General Condition of Concrete	Fair.
Rust or Staining	Yes.
Spalling	Yes.
Any Visible Reinforcing	Yes, on left wall, under road bridge.
Any Seepage or efflorescence	Yes, on both left and right walls. Small seep squirting out of left wall, under road bridge.
Drain Holes	None observed.
c. Discharge Channel	
General Condition	Good.
Loose Rock Overhanging Channel	None.
Trees Overhanging Channel	Some.
Floor of Channel	Gravel, boulders, ledge rock.
Other Obstructions	Trees and old dam 6 feet high, 200 feet downstream.

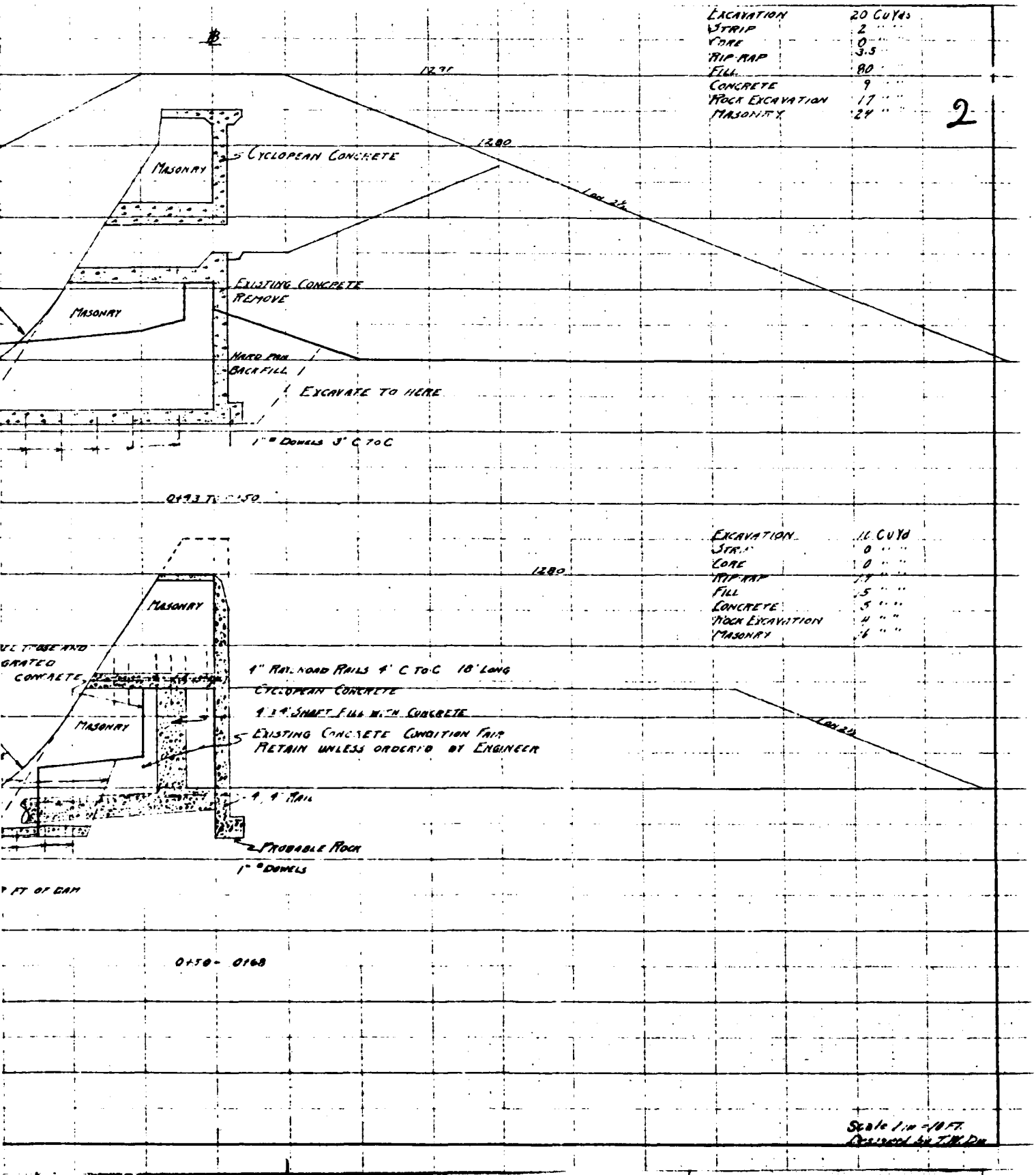
PERIODIC INSPECTION CHECK LIST

PROJECT THURMAN DIX RESERVOIR DATE July 31, 1978

PROJECT FEATURE _____ NAME _____

DISCIPLINE Geotechnical NAME _____

AREA EVALUATED	CONDITION
OUTLET WORKS - SERVICE BRIDGE	
a. Super Structure Bearings Anchor Bolts Bridge Seat Longitudinal Members Under Side of Deck Secondary Bracing Deck Drainage System Railings Expansion Joints Paint	NOTE: (1) The only service structure directly associated with the dam is a ladder attached to the right training wall to provide access to top of the spillway. This ladder is in good condition except for the broken bottom step. (2) The bridge which is supported by the abutments that also form a portion of the training walls for the discharge channel.
b. Abutment & Piers General Condition of Concrete Alignment of Abutment Approach to Bridge Condition of Seat & Backwall	

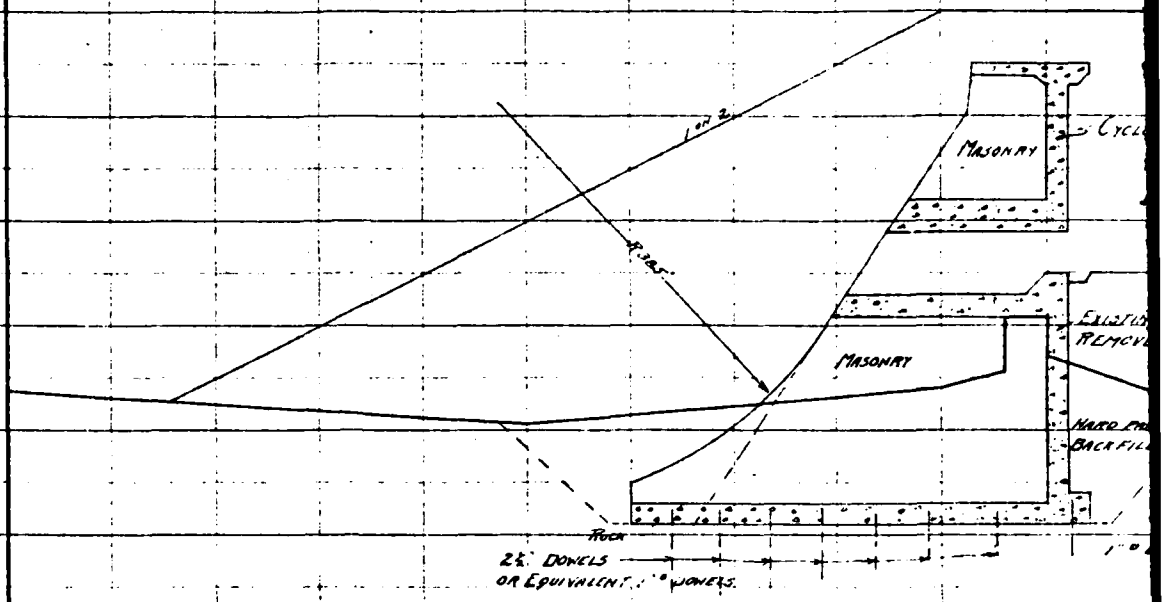


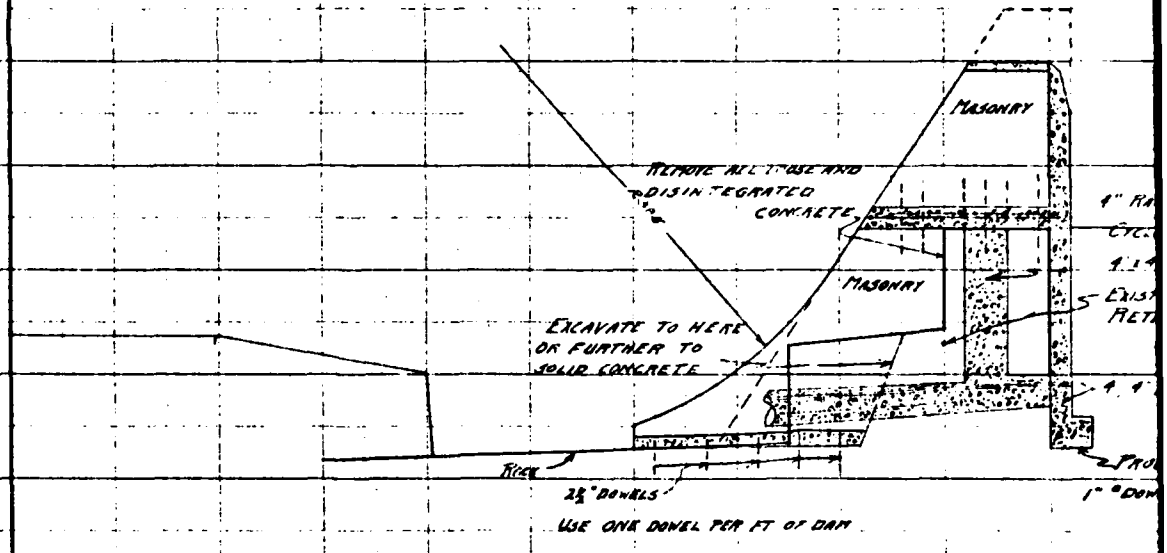
EXCAVATION	20 CU Yds
STRIP	2 " "
CORE	0 " "
RIP-RAP	3.5 " "
FILL	80 " "
CONCRETE	9 " "
ROCK EXCAVATION	17 " "
MASONRY	24 " "

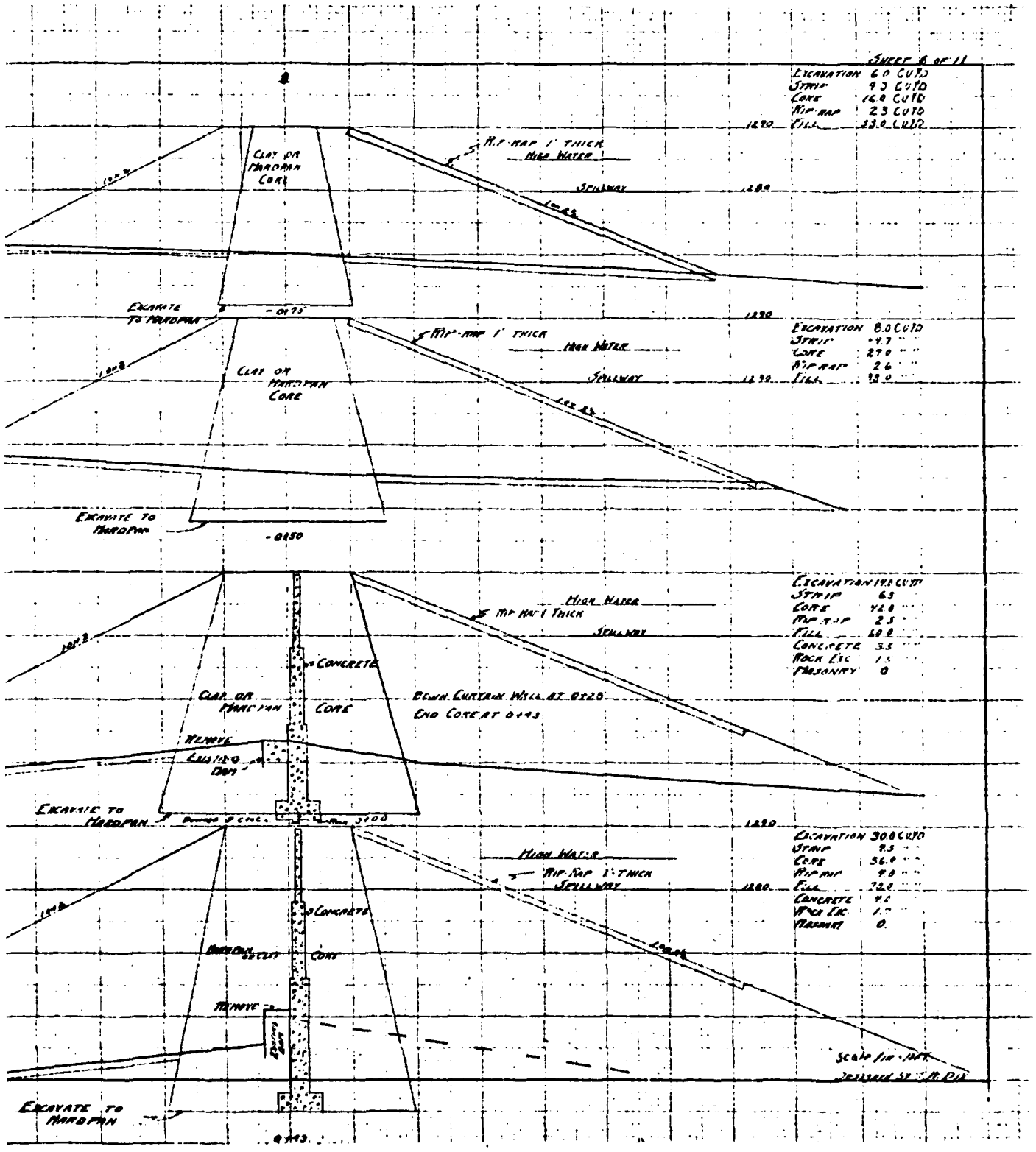
2

EXCAVATION	16 CU Yd
STRIP	0 " "
CORE	0 " "
RIP-RAP	.7 " "
FILL	.5 " "
CONCRETE	.5 " "
ROCK EXCAVATION	4 " "
MASONRY	.6 " "

Scale 1 in = 10 FT.
Designed by T.W. Dix


MASONRY
MASONRY
ROCK
2½" DOWELS
OR EQUIVALENT


MASONRY
REMOVE ALL LOOSE AND
DISINTEGRATED
CONCRETE
MASONRY
EXCAVATE TO HERE
OR FURTHER TO
SOLID CONCRETE
ROCK
2½" DOWELS
USE ONE DOWEL PER FT OF DAM

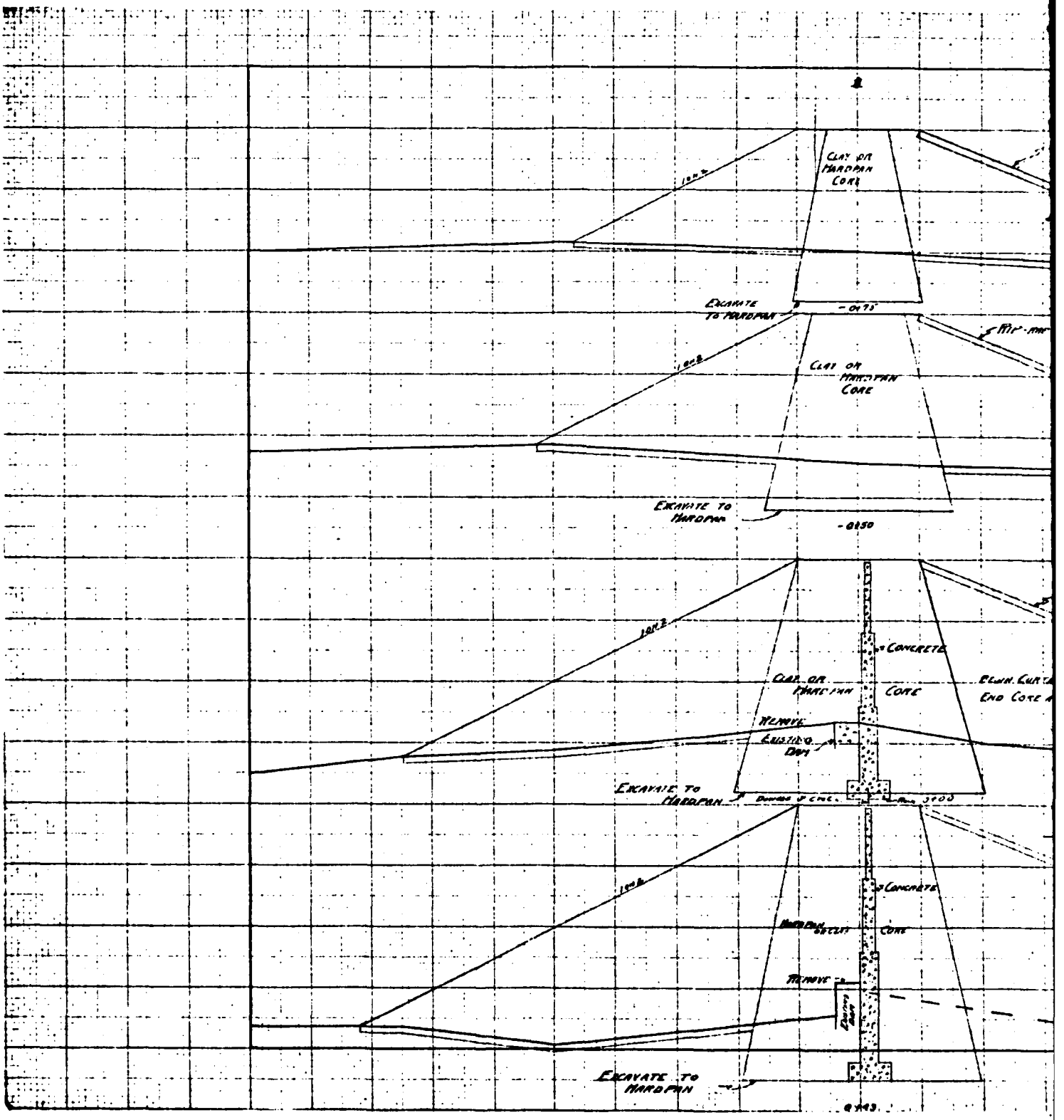


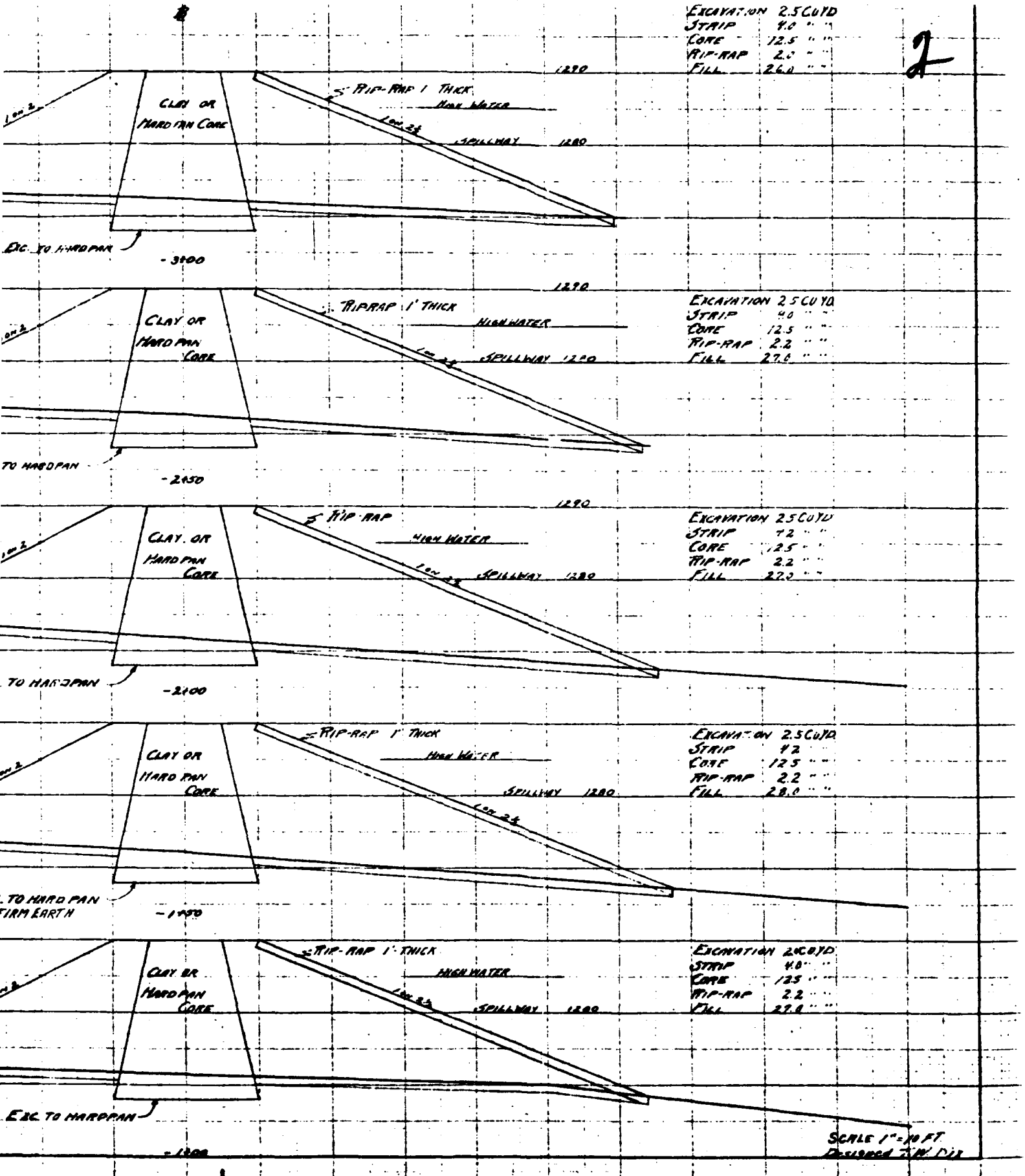
EXCAVATION	6.0 CU YD
STRIP	9.3 CU YD
CORE	16.0 CU YD
RIP-RAP	2.5 CU YD
FILL	33.0 CU YD

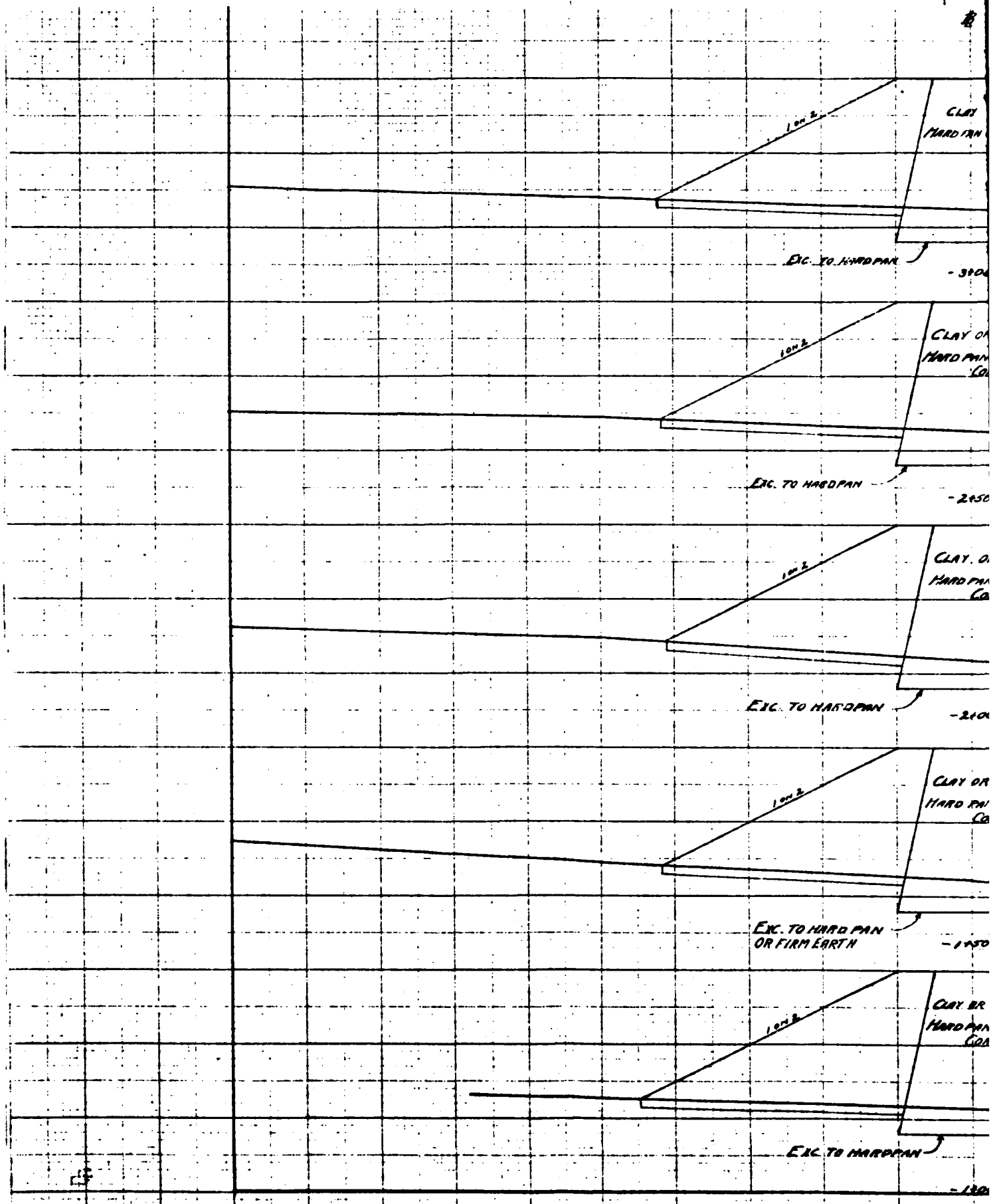
EXCAVATION	8.0 CU YD
STRIP	4.7 " "
CORE	27.0 " "
RIP-RAP	2.6 " "
FILL	33.0 " "

EXCAVATION	192 CU YD
STRIP	63 " "
CORE	42.0 " "
RIP-RAP	2.5 " "
FILL	60.0 " "
CONCRETE	3.5 " "
ROCK EXC	1.5 " "
MASONRY	0

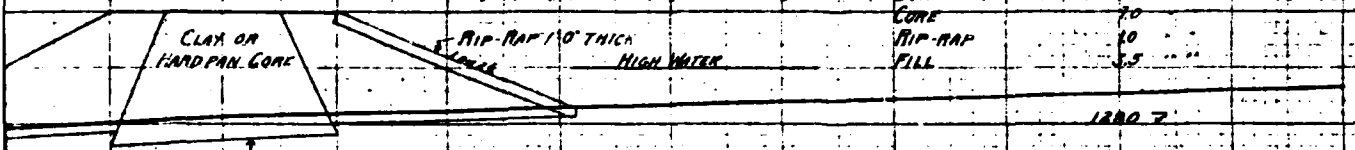
EXCAVATION	30.0 CU YD
STRIP	9.5 " "
CORE	56.0 " "
RIP-RAP	9.0 " "
FILL	72.0 " "
CONCRETE	9.0
ROCK EXC	1.5
MASONRY	0.


CLAY OR HARDPAN CORE
EXCAVATE TO HARDPAN
CLAY OR HARDPAN CORE
EXCAVATE TO HARDPAN
CONCRETE
CLAY OR HARDPAN CORE
REMOVE
EXISTING DAM
EXCAVATE TO HARDPAN
CONCRETE
CORE
REMOVE
EXCAVATE TO HARDPAN

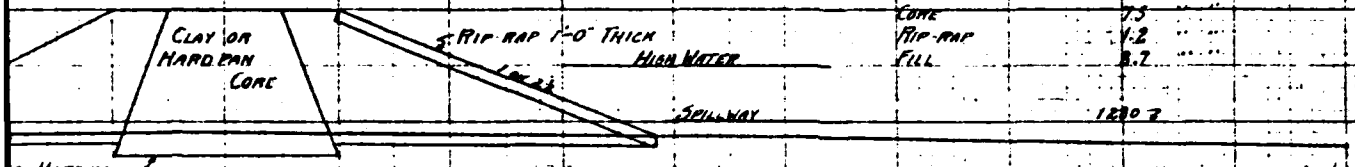

CLAY OR HARD PAN CORE
1 on 2
5" RIP-RAP 1' THICK
HIGH WATER
1 on 2½
SPILLWAY 1280
1290
EXC. TO HARDPAN
-3400
EXCAVATION 2.5 CU YD
STRIP 4.0 " "
CORE 12.5 " "
RIP-RAP 2.0 " "
FILL 26.0 " "
2
CLAY OR HARD PAN CORE
1 on 2
RIPRAP 1' THICK
HIGH WATER
1 on 2½
SPILLWAY 1280
1290
TO HARDPAN
-2450
EXCAVATION 2.5 CU YD
STRIP 4.0 " "
CORE 12.5 " "
RIP-RAP 2.2 " "
FILL 27.0 " "
CLAY OR HARD PAN CORE
1 on 2
RIP-RAP
HIGH WATER
1 on 2½
SPILLWAY 1280
1290
TO HARDPAN
-2400
EXCAVATION 2.5 CU YD
STRIP 7.2 " "
CORE 12.5 " "
RIP-RAP 2.2 " "
FILL 22.0 " "
CLAY OR HARD PAN CORE
1 on 2
RIP-RAP 1' THICK
HIGH WATER
SPILLWAY 1280
1 on 2½
TO HARD PAN FIRM EARTH
-1450
EXCAVATION 2.5 CU YD
STRIP 4.2
CORE 12.5 " "
RIP-RAP 2.2 " "
FILL 28.0 " "
CLAY OR HARD PAN CORE
1 on 2
RIP-RAP 1' THICK
HIGH WATER
1 on 2½
SPILLWAY 1280
EXC. TO HARDPAN
-1200
EXCAVATION 2.5 CU YD
STRIP 4.0 " "
CORE 12.5 " "
RIP-RAP 2.2 " "
FILL 27.0 " "
SCALE 1" = 10 FT.
Designed 2 M' Dia


1 on 2
CLAY
HARD PAN
EXC. TO HARDPAN
1 on 2
EXC. TO HARDPAN
1 on 2
EXC. TO HARDPAN
1 on 2
EXC. TO HARD PAN
OR FIRM EARTH
1 on 2
EXC. TO HARDPAN

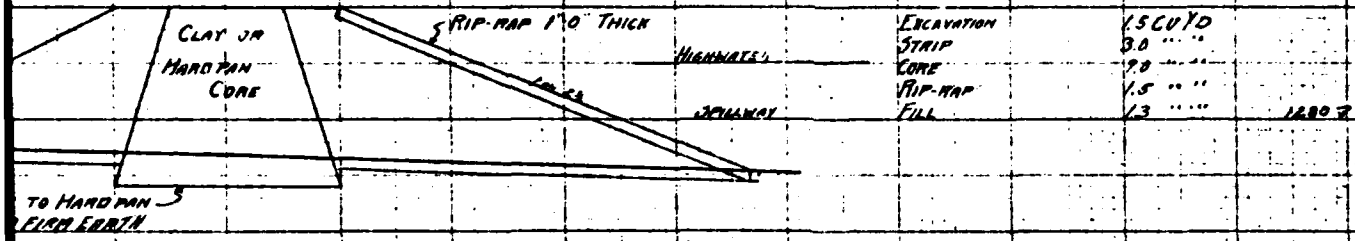
END AT 5+50



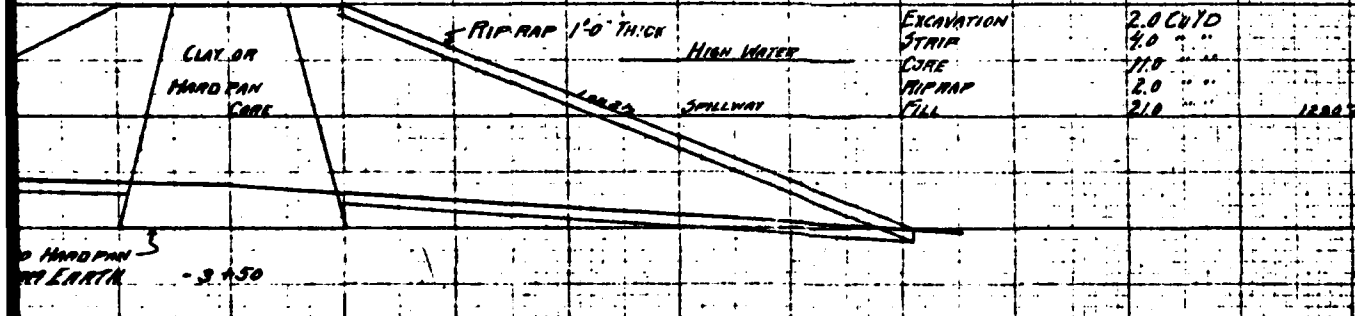
EXCAVATION 1.0 CU.YD
STRIP 2.5 " "
CORE 7.0 " "
RIP-RAP 1.0 " "
FILL 5.5 " "
1280 ℄



EXCAVATION 1.0 CU.YD
STRIP 2.7 " "
CORE 7.5 " "
RIP-RAP 1.2 " "
FILL 8.2 " "
1280 ℄

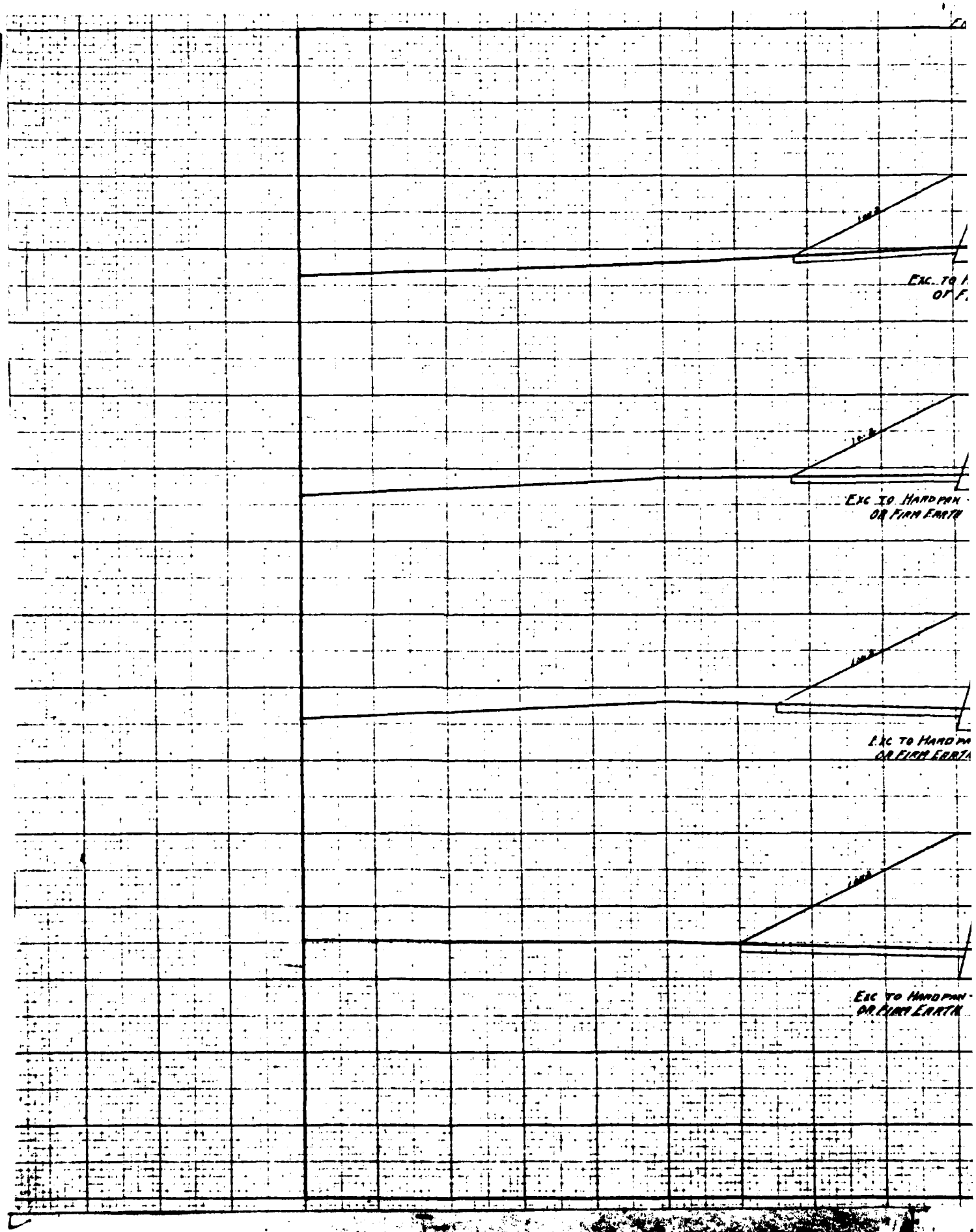


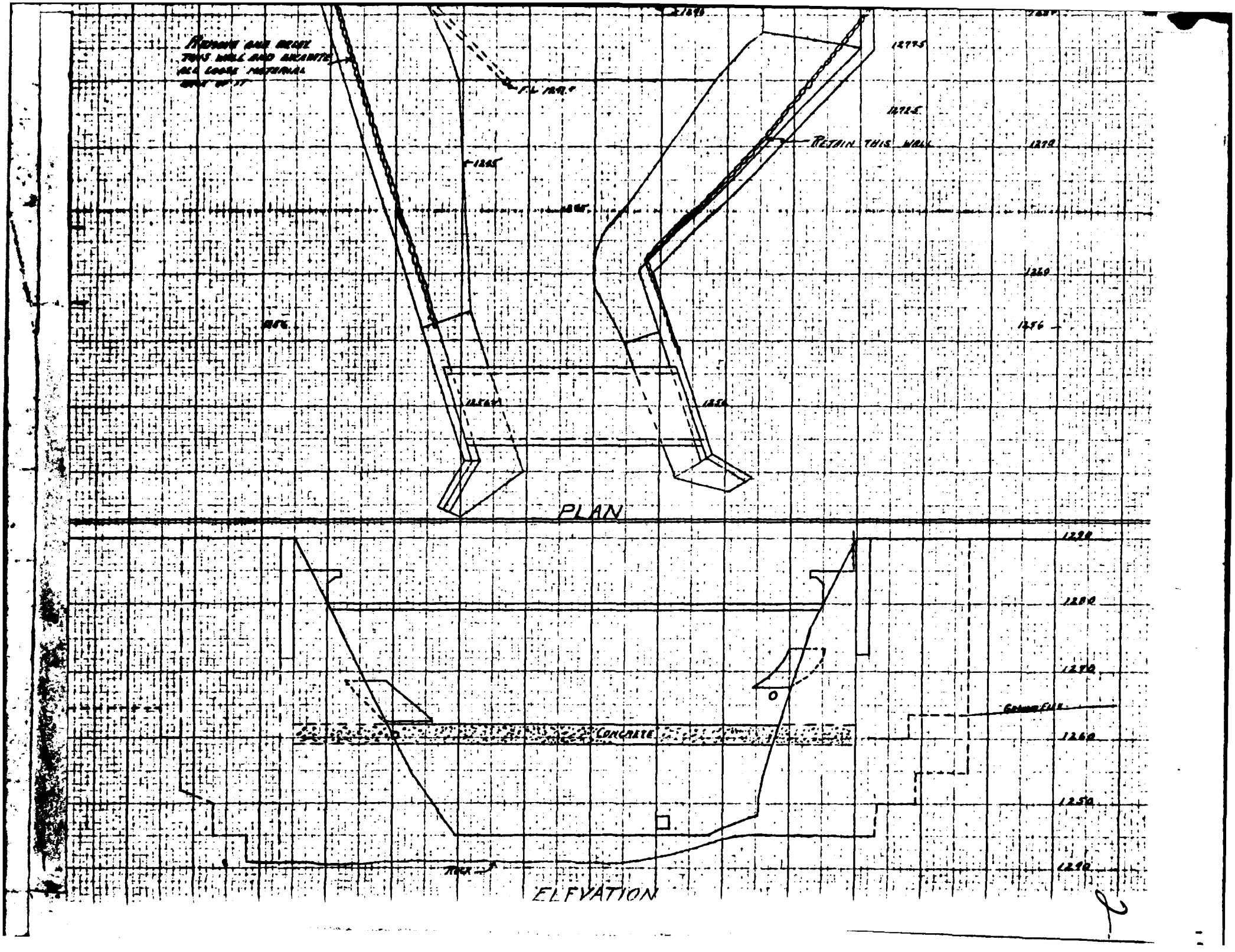
EXCAVATION 1.5 CU.YD
STRIP 3.0 " "
CORE 9.0 " "
RIP-RAP 1.5 " "
FILL 13 " "
1280 ℄

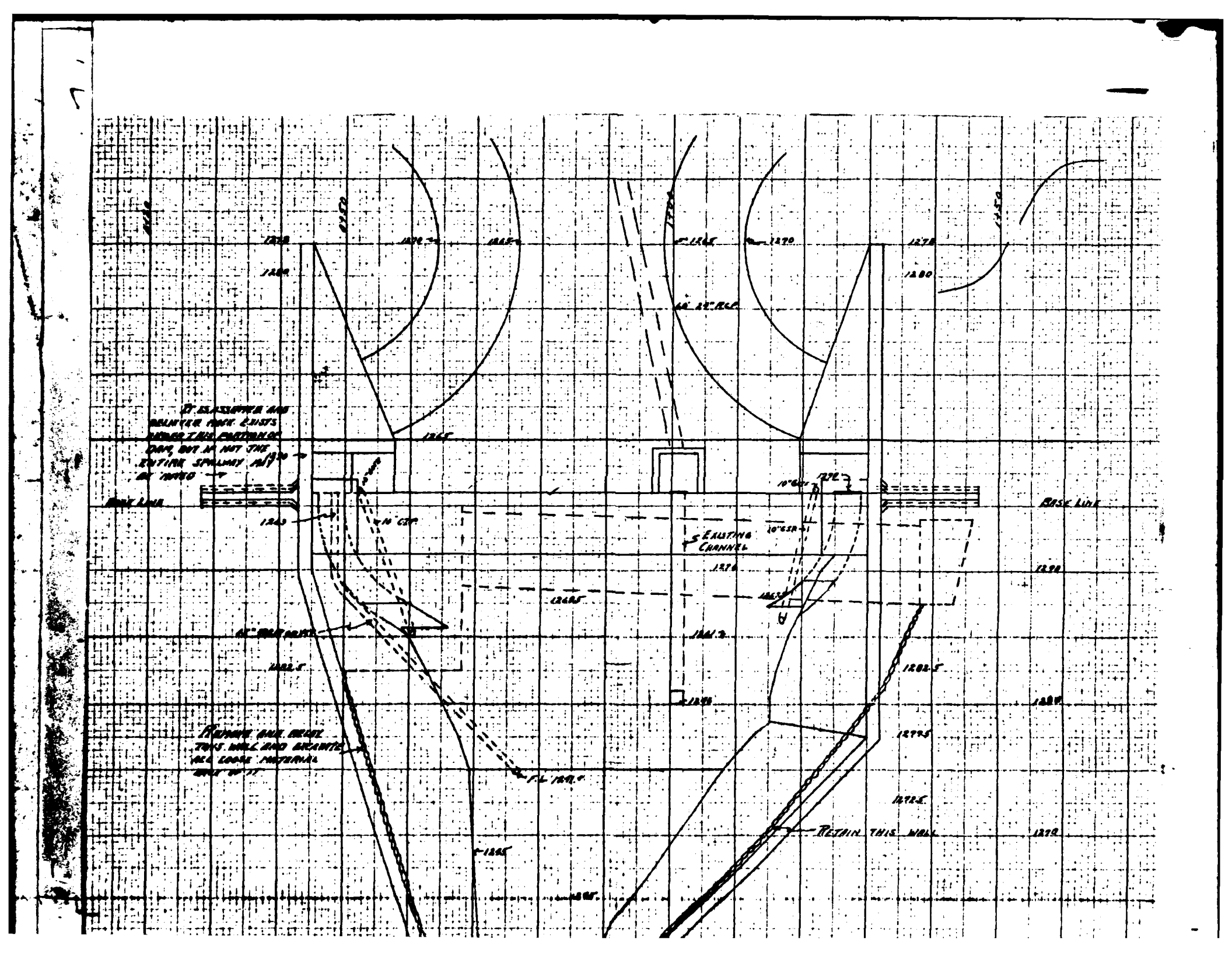


EXCAVATION 2.0 CU.YD
STRIP 4.0 " "
CORE 11.0 " "
RIP-RAP 2.0 " "
FILL 21.0 " "
1280 ℄

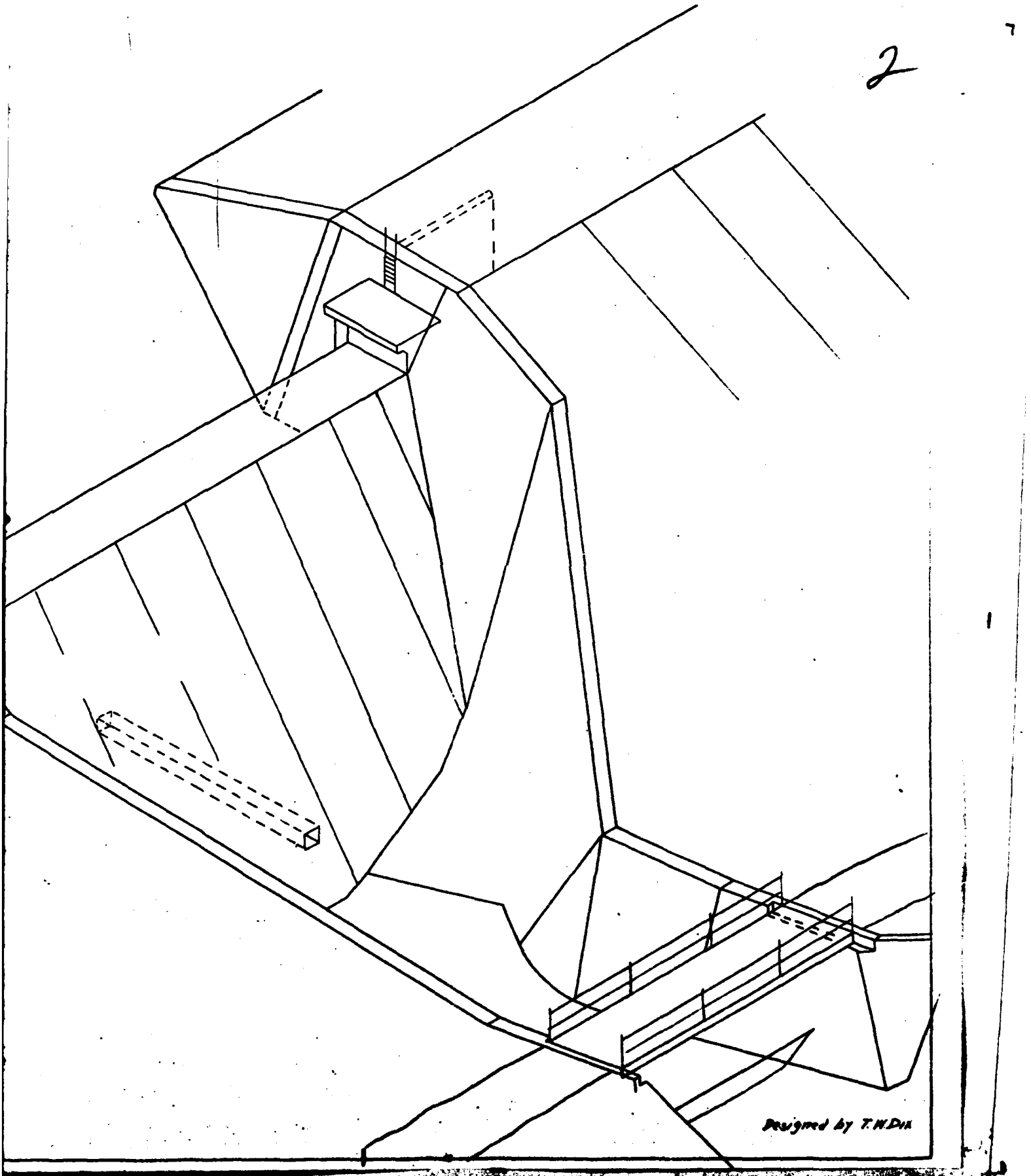
SCALE 1"=10 F.T.

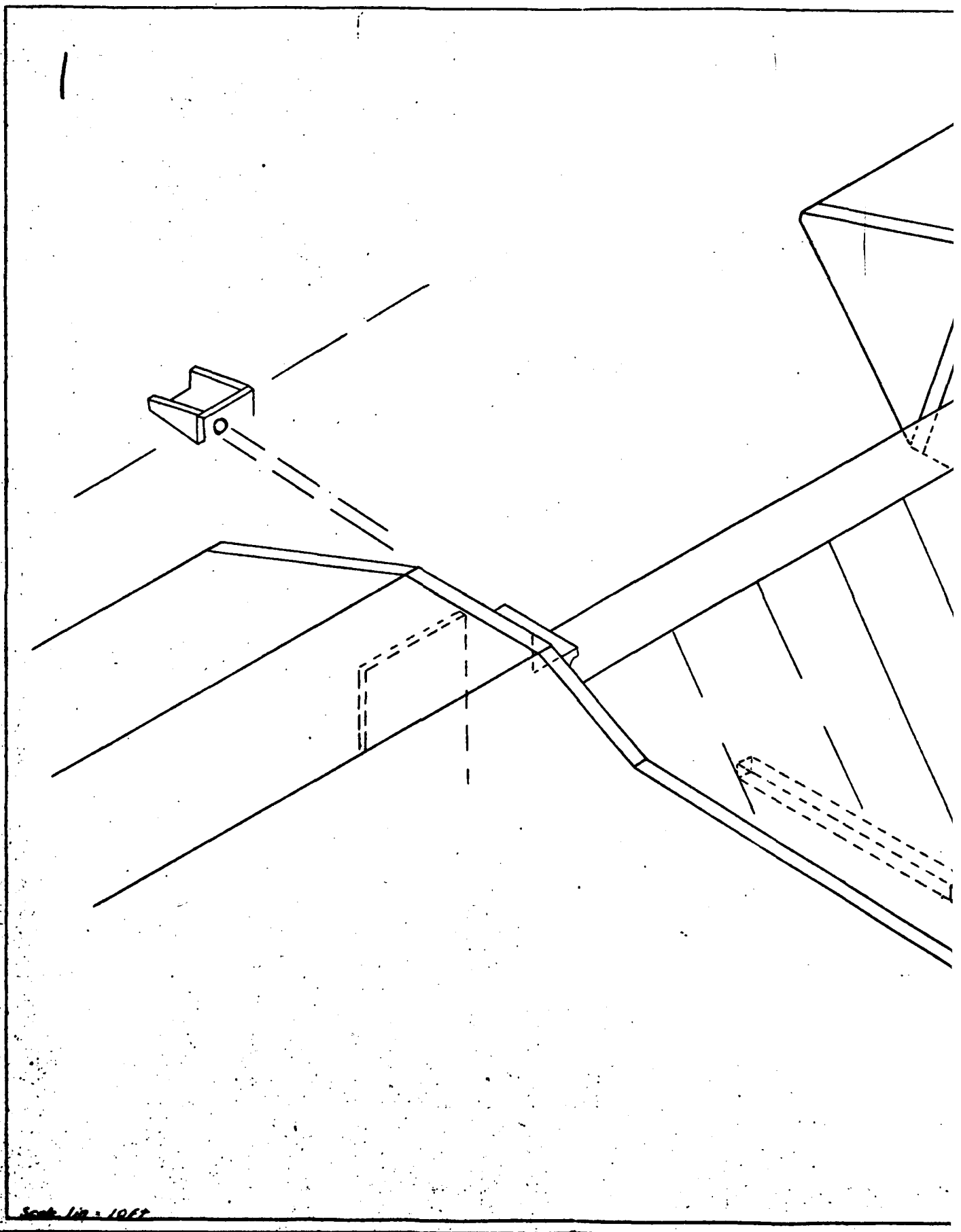

EXC. TO
OR F
EXC TO HARDPAN
OR FIRM EARTH
EXC TO HARDPAN
OR FIRM EARTH
EXC TO HARDPAN
OR FIRM EARTH


RETAIN THIS WALL
PLAN
CONCRETE
ROCK
ELEVATION


EXISTING CHANNEL
RETAIN THIS WALL
BASE LINE

2




Scale 1/8" = 1'0"

VERMONT DEPARTMENT OF WATER RESOURCES

INFORMATION SHEET

Name of Dam D. Reservoir * Town Orange

Owner City of Barre Name of Stream Orange Brook

Address C/o Hall Classification II

Barre Vermont 05641

U.S.G.S. Coordinates: Lat. 44°-10'-52" Long. 72°-29'-31"

U.S.G.S. Map E. of Barre Aerial Photos VT-62-1 49-13 to 14
VT7420 16-150 to 151

U.S.G.S. Elev. @ Spillway 1280

Total Length of Dam 1000 ft Crest Width of Emergency Spillway 2 ft

Width of Top 10 ft Maximum Height 50 ft

Spillway Capacity: Principal _____ Emergency _____

Pond Area 124 Acres Drainage Area 9.2 Sq. Mi.

Pond Volume: Normal Water Level _____ Design High Water Level _____

Maximum Water Depth: Normal Water Level _____ Design High Water Level _____

Storage Before Emergency Spillway is Used None

Use of Reservoir Water Supply

Description of Dam: Earth fill

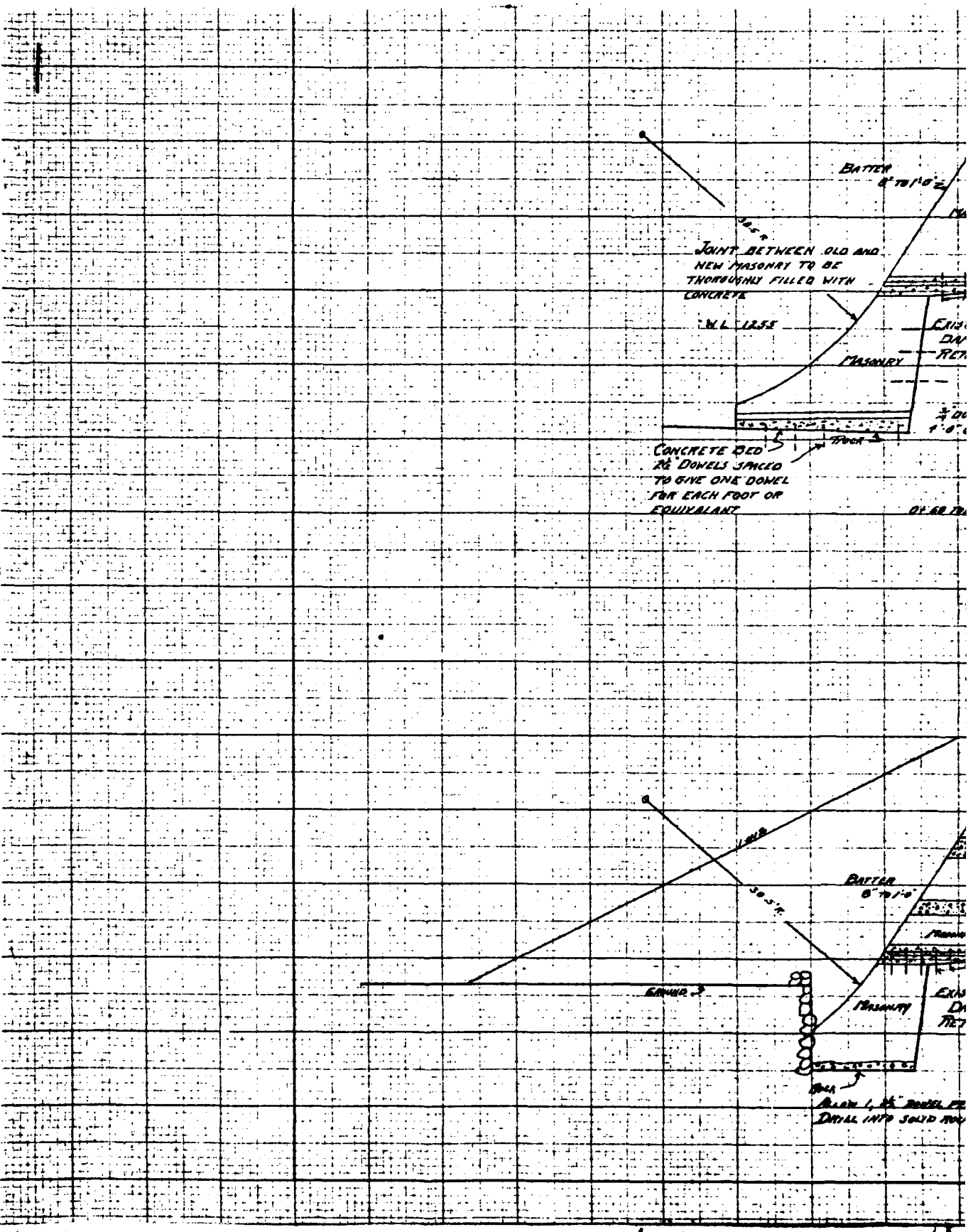
Description of Spillway(s): Concrete over flow weir with flash boards

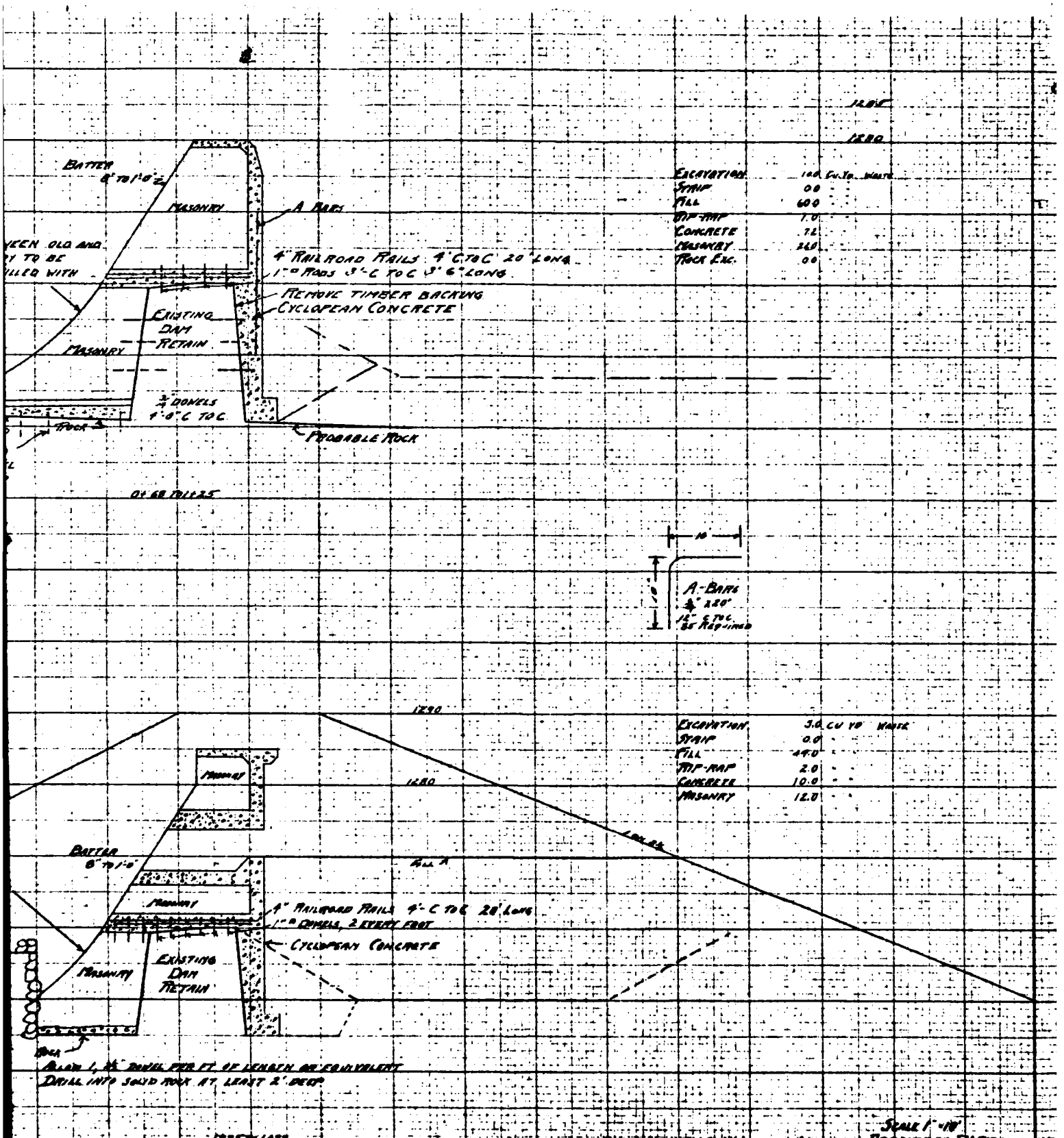
Designed by Thurman W. Dix Year Built 1950

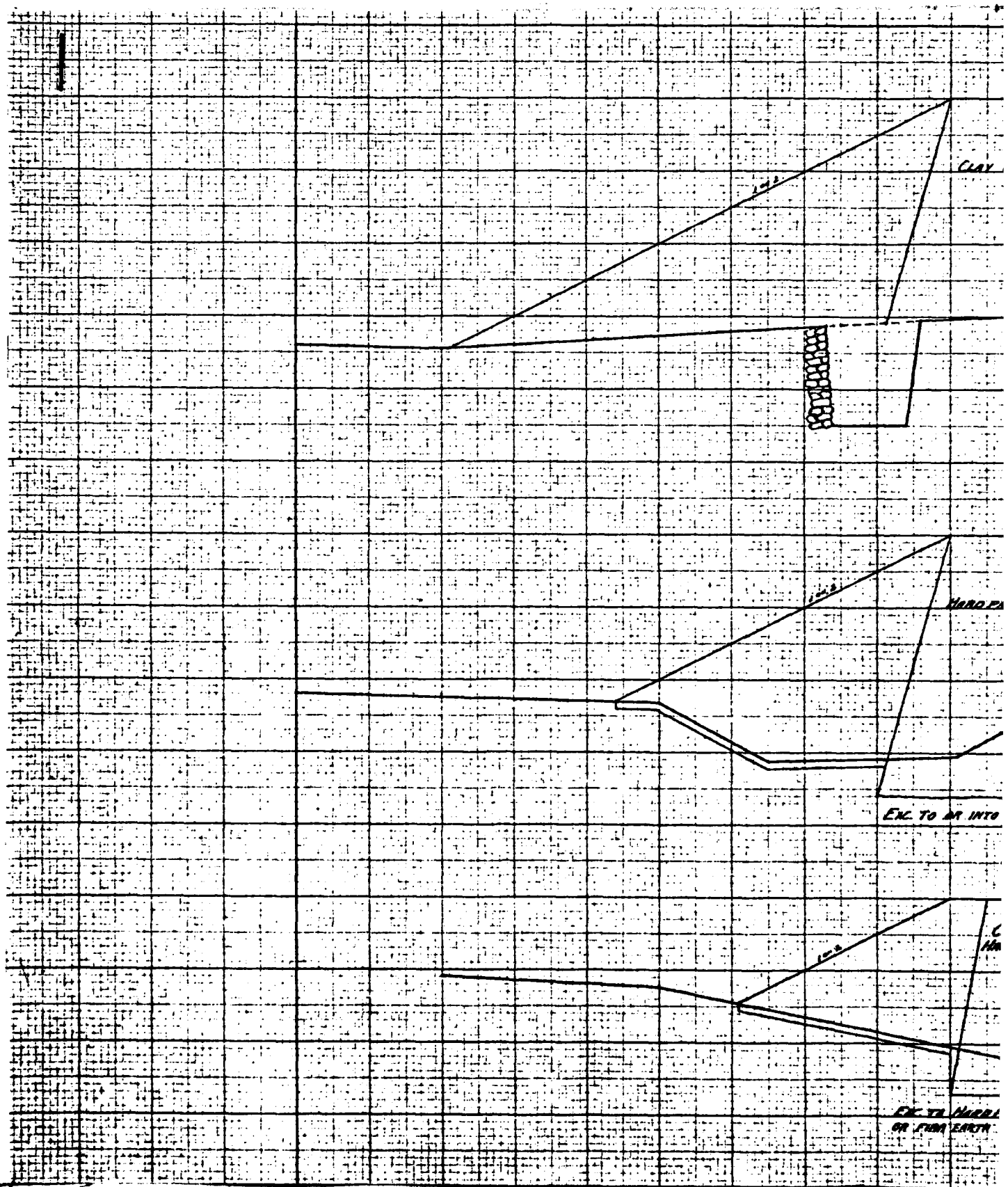
Hearing Date _____ Order Date _____

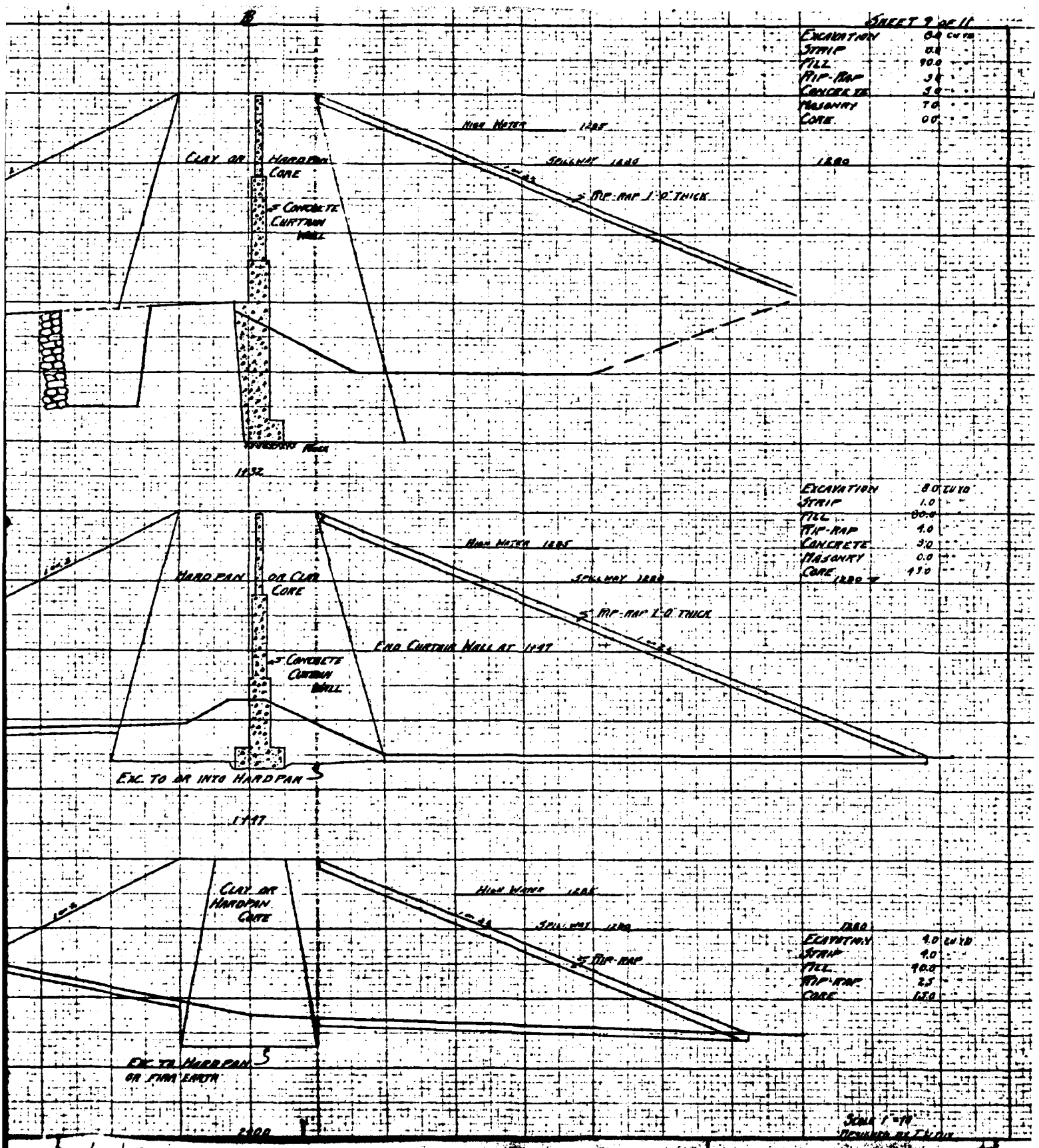
APPENDIX B

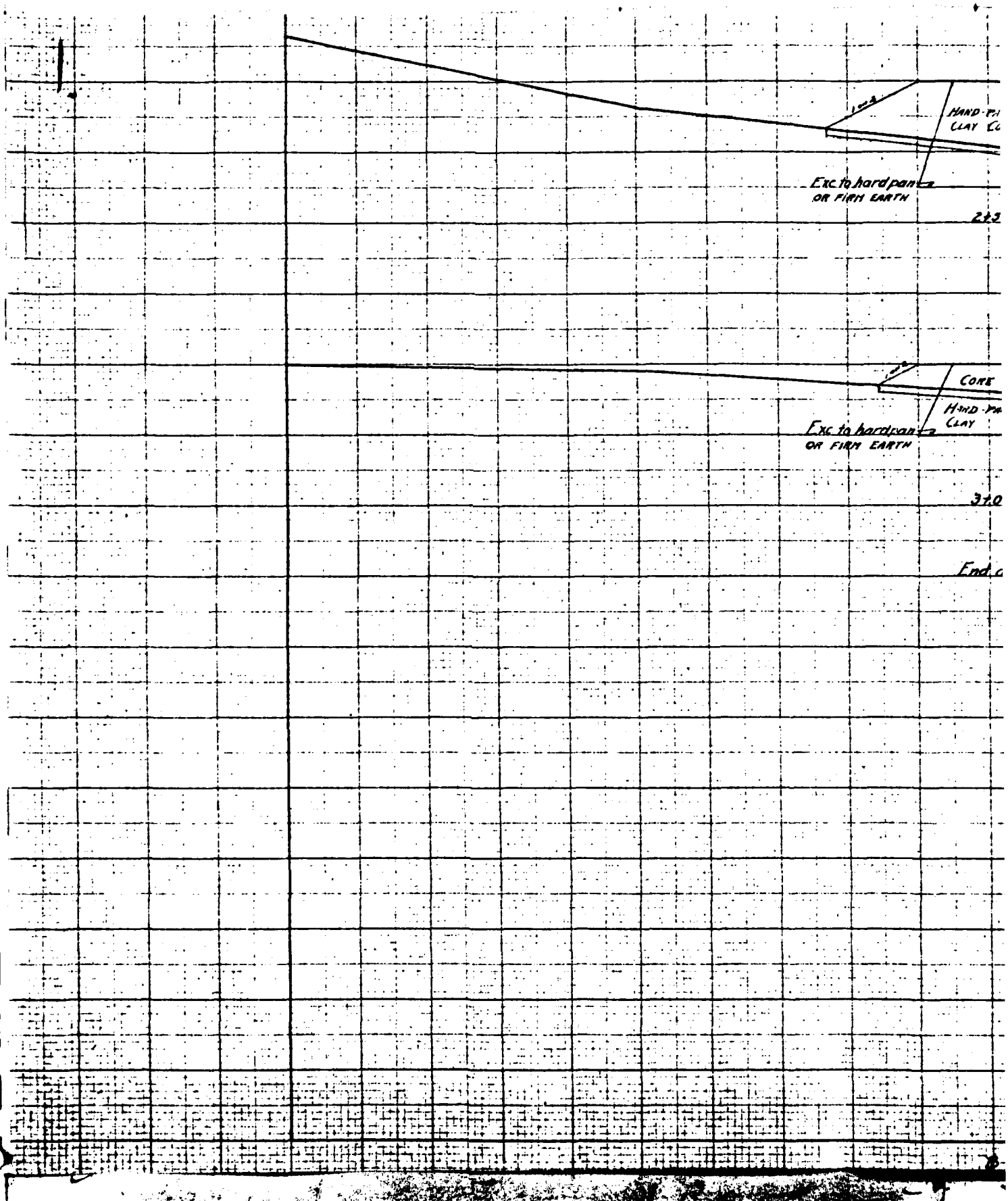
Project Records and Plans


BATTER
JOINT BETWEEN OLD AND NEW MASONRY TO BE THOROUGHLY FILLED WITH CONCRETE
W.L. 1255
MASONRY
CONCRETE BED
DOWELS SPACED TO GIVE ONE DOWEL FOR EACH FOOT OR EQUIVALANT
BATTER
MASONRY

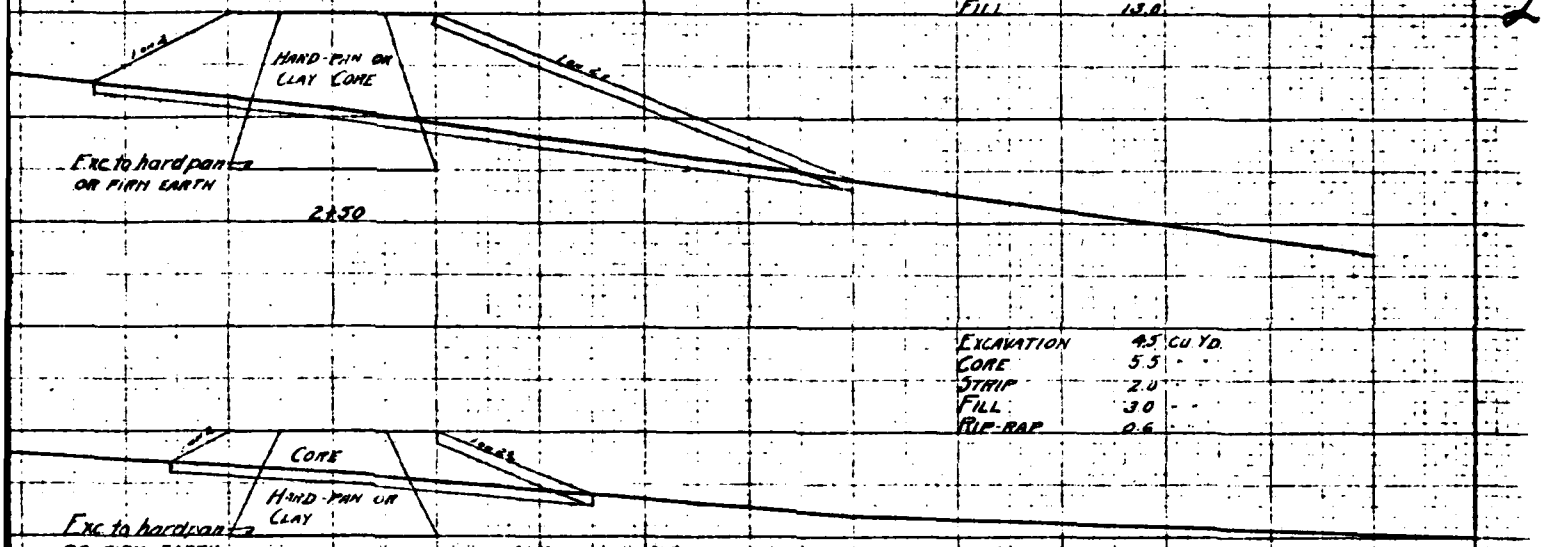

1280
1280
BATTER
6" TO 1'-0"
MASONRY
A BARS
4" RAILROAD RAILS 4'-C TO C 20' LONG
1" ø RODS 3'-C TO C 3'-6" LONG
REMOVE TIMBER BACKING
CYCLOPEAN CONCRETE
EXISTING DAM RETAIN
MASONRY
¾" DOWELS 4'-0" C TO C
ROCK
PROBABLE ROCK
EXCAVATION 100 CU YD WASTE
STRIP 0.0
FILL 600
RIP-RAP 7.0
CONCRETE 7.2
MASONRY 26.0
ROCK EXC. 0.0
10'
A-BARS ¾" X 20' 12" C TO C AS REQUIRED
1290
1280
BATTER 6" TO 1'-0"
MASONRY
A
A
4" RAILROAD RAILS 4'-C TO C 20' LONG
1" ø DOWELS, 2 EVERY FOOT
CYCLOPEAN CONCRETE
MASONRY
EXISTING DAM RETAIN
ROCK
DRILL 1, 1¼" HOLES PER FT. OF LENGTH OR EQUIVALENT
DRILL INTO SOLID ROCK AT LEAST 2' DEEP
EXCAVATION 3.0 CU YD WASTE
STRIP 0.0
FILL 44.0
RIP-RAP 2.0
CONCRETE 10.0
MASONRY 12.0
SCALE 1" = 10'
DRAWN BY EM GH


CLAY
EXC. TO BE INTO


CLAY OR HARDPAN CORE
5' CONCRETE CURTAIN WALL
HIGH WATER 1885
SPILLWAY 1880
1880
RIP-RAP 1'-0" THICK
1832
EXCAVATION 8.0 CU YD
STRIP 1.0
FILL 90.0
RIP-RAP 4.0
CONCRETE 3.0
MASONRY 0.0
CORE 49.0
1880
HARD PAN OR CLAY CORE
HIGH WATER 1885
SPILLWAY 1880
RIP-RAP 1'-0" THICK
END CURTAIN WALL AT 1847
5' CONCRETE CURTAIN WALL
EXC. TO OR INTO HARDPAN
1847
CLAY OR HARDPAN CORE
HIGH WATER 1885
SPILLWAY 1880
RIP-RAP
EXC. TO HARDPAN OR FIRM EARTH
1800
1880
EXCAVATION 9.0 CU YD
STRIP 1.0
FILL 90.0
RIP-RAP 2.5
CORE 1.5.0
SCALE 1"=10'
REDUCED AS THIS


Exc. to hardpan
OR FIRM EARTH
Exc. to hardpan
OR FIRM EARTH

EXCAVATION	9 CU YD
RIP-RAP	1.5 " "
CORE	8.3 " "
STRIP	3.0 " "
FILL	13.0 " "



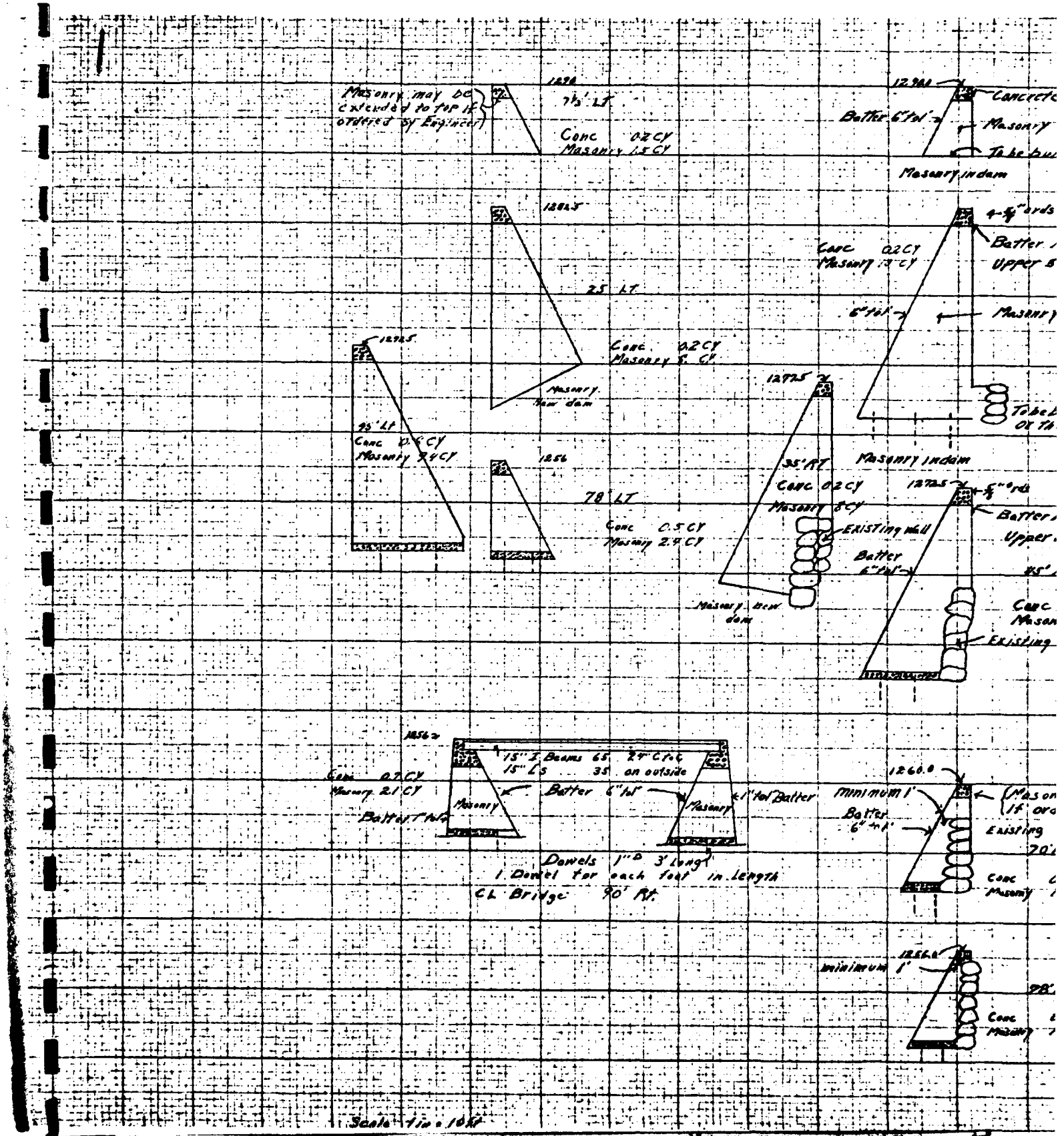
2+50

EXCAVATION	4.5 CU YD.
CORE	5.5 " "
STRIP	2.0 " "
FILL	3.0 " "
RIP-RAP	0.6 " "

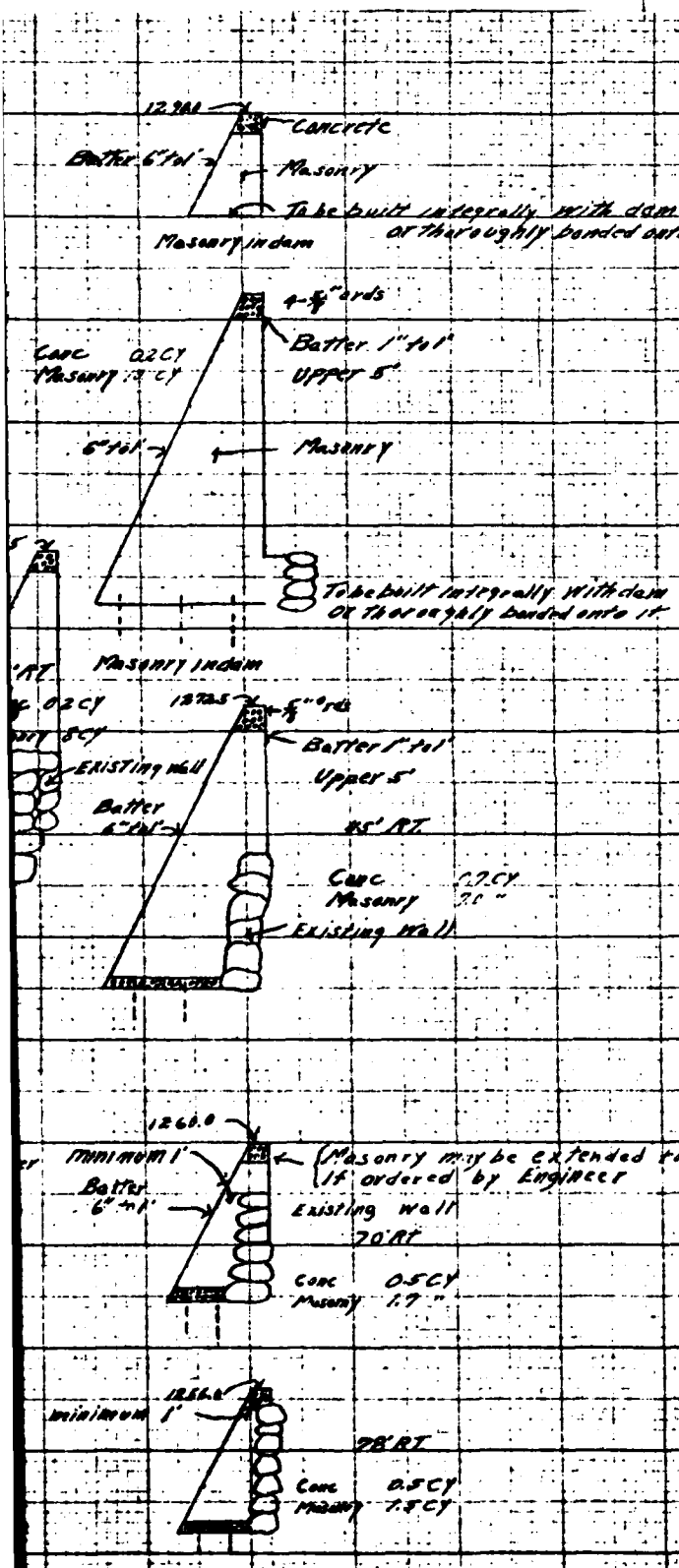
3+00

End at 3+50

SCALE 1"=10'


Masonry may be extended to top if ordered by Engineer
1278
7½' LT
Conc 0.2 CY
Masonry 1.5 CY
12782
Concrete
Batter 6"/ft
Masonry
To be bu
Masonry in dam
12845
25' LT
Conc 0.2 CY
Masonry 3. CY
Masonry new dam
4-4" ords
Batter
Upper B
Conc 0.2 CY
Masonry 1.3 CY
6"/ft
Masonry
To be
Or Th
12795
93' LT
Conc 0.5 CY
Masonry 2.4 CY
1256
78' LT
Conc 0.5 CY
Masonry 2.4 CY
12795
35' RT
Conc 0.2 CY
Masonry 8 CY
EXISTING WALL
Batter 6"/ft
Masonry new dam
Masonry in dam
12795
4" ords
Batter
Upper
Conc
Mason
Existing
1256.2
15" I Beams 65 2'-4" C to C
15" Ls 35 on outside
Conc 0.7 CY
Masonry 2.1 CY
Batter 6"/ft
Masonry
Batter 6"/ft
Masonry
Batter
Dowels 1" D 3' Long
1 Dowel for each foot in length
CL Bridge 90° Rt.
1260.0
minimum 1'
Batter 6" in 1'
Mason
If ord
Existing
Conc
Masonry
1256.0
Minimum 1'
Conc
Masonry
Scale 1in = 10ft

2



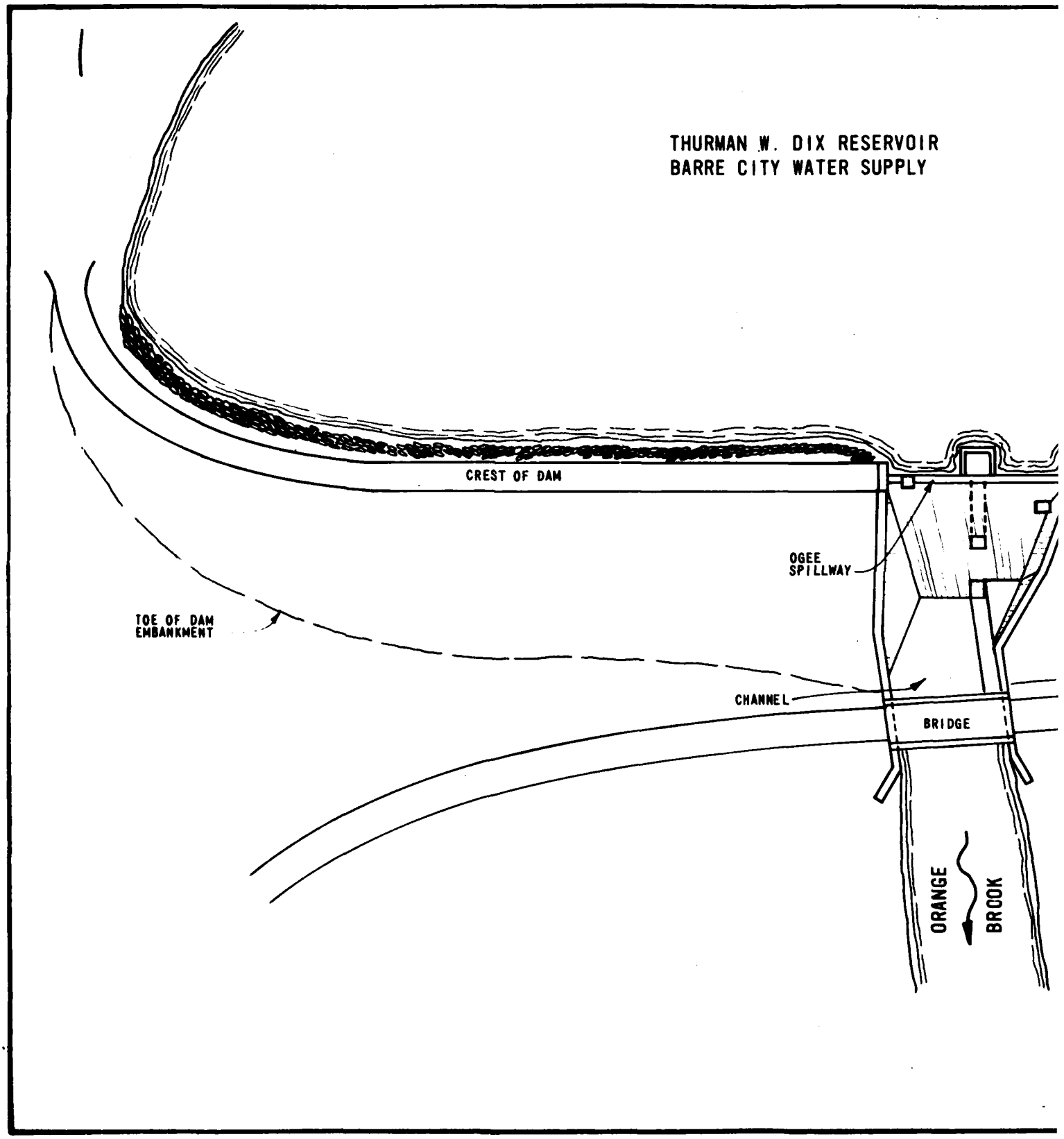
Left Side				Looking UP	
Point	Dist	Conc	CY	Masonry	CY
1		0.3		1.5	
2	15	0.3	3.6	8	85.5
3	23	0.8	7.0	9.4	174.0
4	33	0.5	2.5	2.4	17.0
5	32	0.7	1.2	2.1	7.2.0
			54.3		526.5

Right Side				Looking UP	
		0.2		1.5	
2	18	0.2	3.6	10.0	103.5
3	10	0.2	2.0	5.0	90.0
4	10	0.7	4.5	7.0	75.0
5	25	0.6	15.0	7.0	133.8
6		0.5	4.0	1.5	12.8
7	32	0.7	1.2	2.1	57.6
			48.3		452.7
		Say	125		1100

Exc	1000 CY
Conc	125
Masonry	1100
Dowels	120

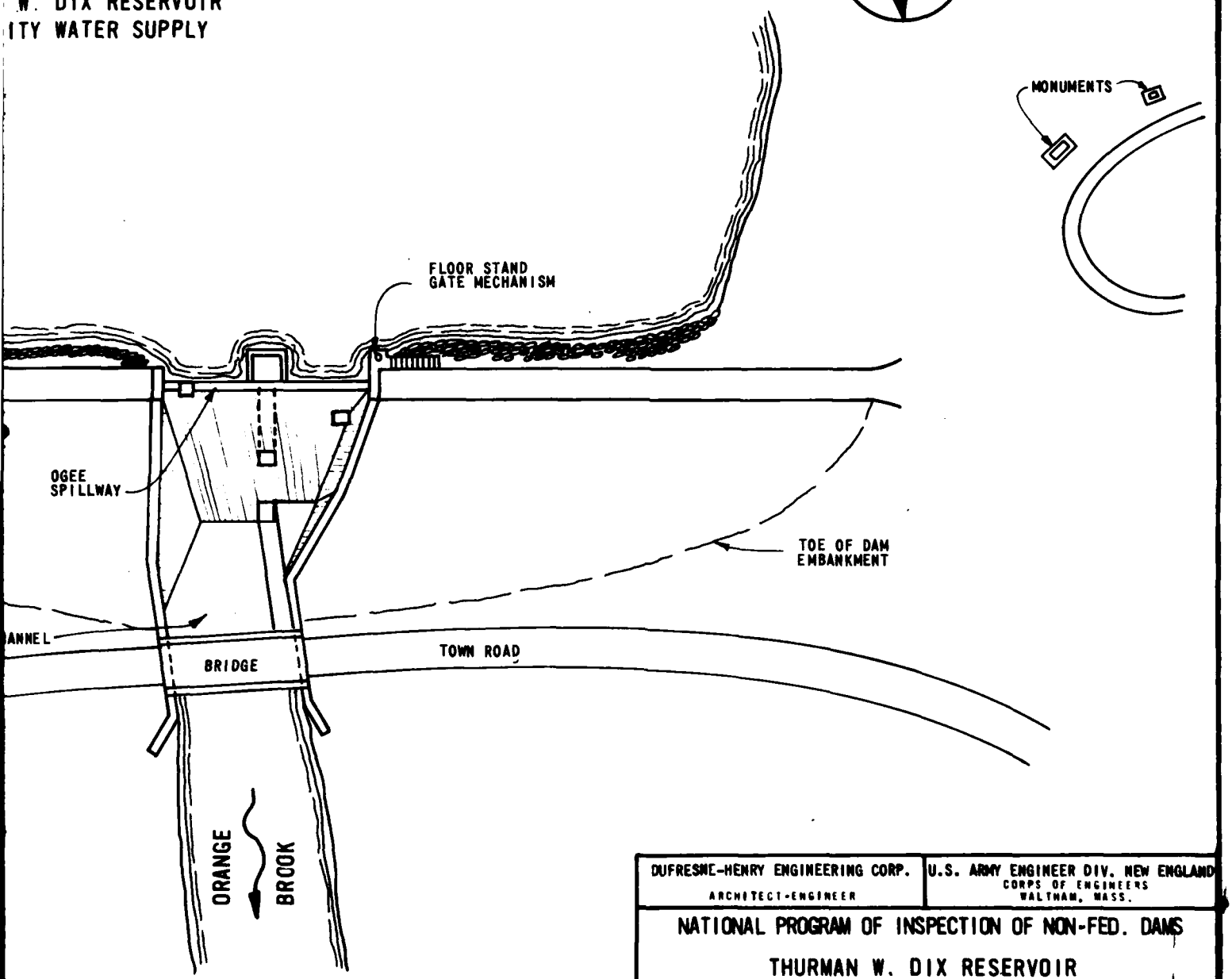
Dowels under dam		280
Dowels Conc. to Masonry		233
6400" Hor ⅝"ø Bars @ .61	=	3900 Lbs
6900" Ver ⅝"ø " @ .66	=	4500 Lbs
L ½" 75+20 X .6	=	1000 Lbs
		2,760 Lbs
		15,000 "

Designed by T.W.D.


THURMAN W. DIX RESERVOIR
BARRE CITY WATER SUPPLY
CREST OF DAM
OGEE
SPILLWAY
TOE OF DAM
EMBANKMENT
CHANNEL
BRIDGE
ORANGE
BROOK

2

W. DIX RESERVOIR
ITY WATER SUPPLY



DUFRESNE-HENRY ENGINEERING CORP. ARCHITECT-ENGINEER	U.S. ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASS.

NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

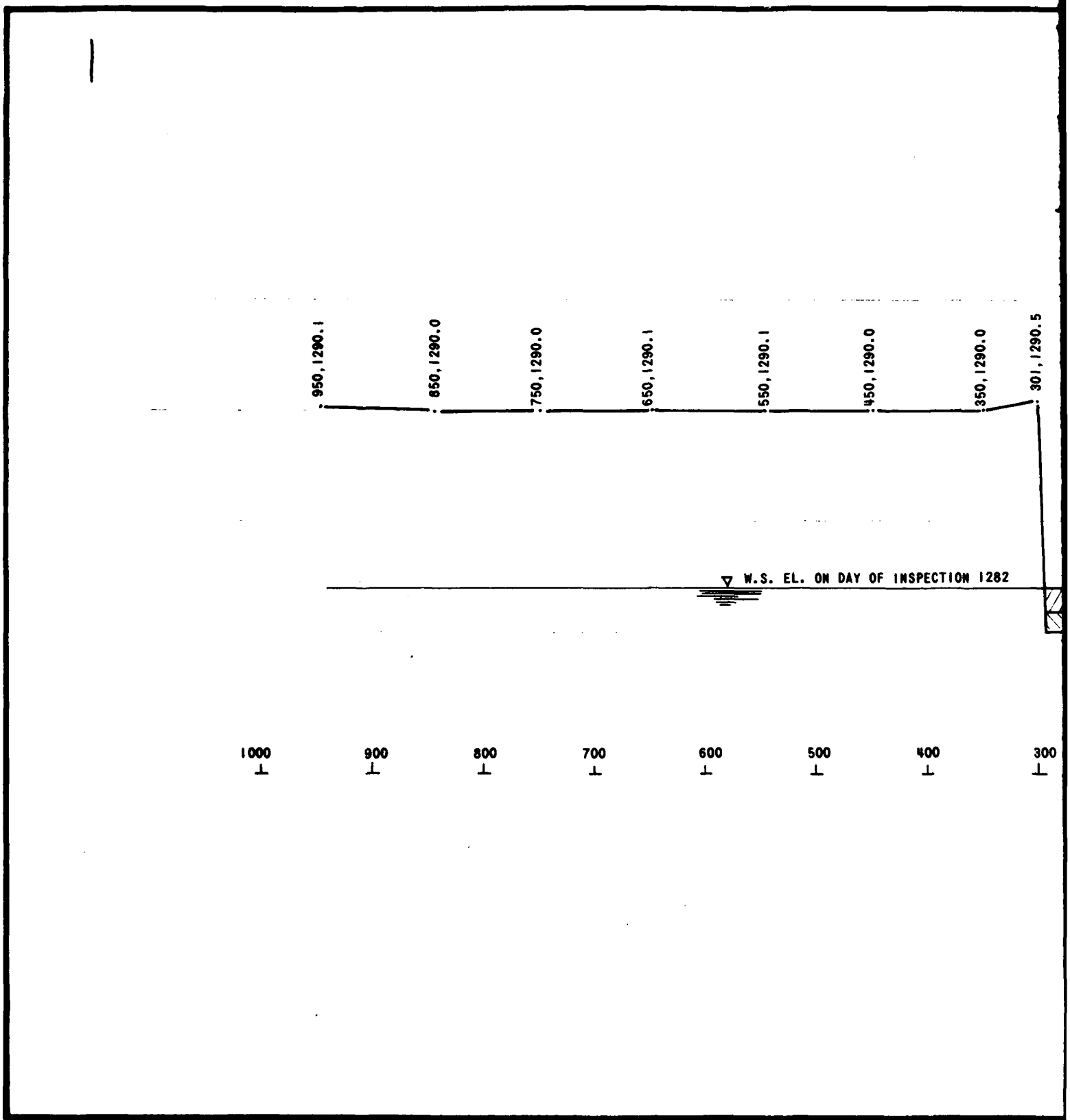
THURMAN W. DIX RESERVOIR

SKETCH PLAN

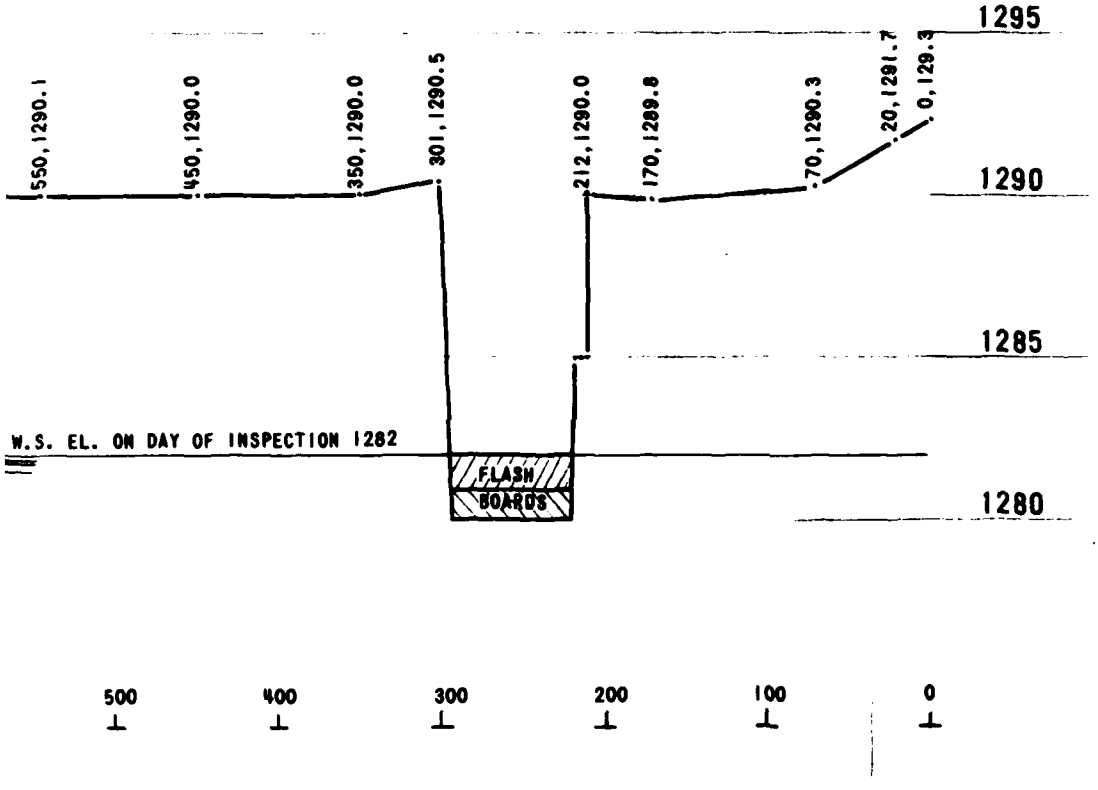
ORANGE VERMONT

SCALE NTS

DATE


950, 1290.1
850, 1290.0
750, 1290.0
650, 1290.1
550, 1290.1
450, 1290.0
350, 1290.0
301, 1290.5
W.S. EL. ON DAY OF INSPECTION 1282
1000
900
800
700
600
500
400
300

2



DUFRESNE-HENRY ENGINEERING CORP. ARCHITECT-ENGINEER	U.S. ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASS.

NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

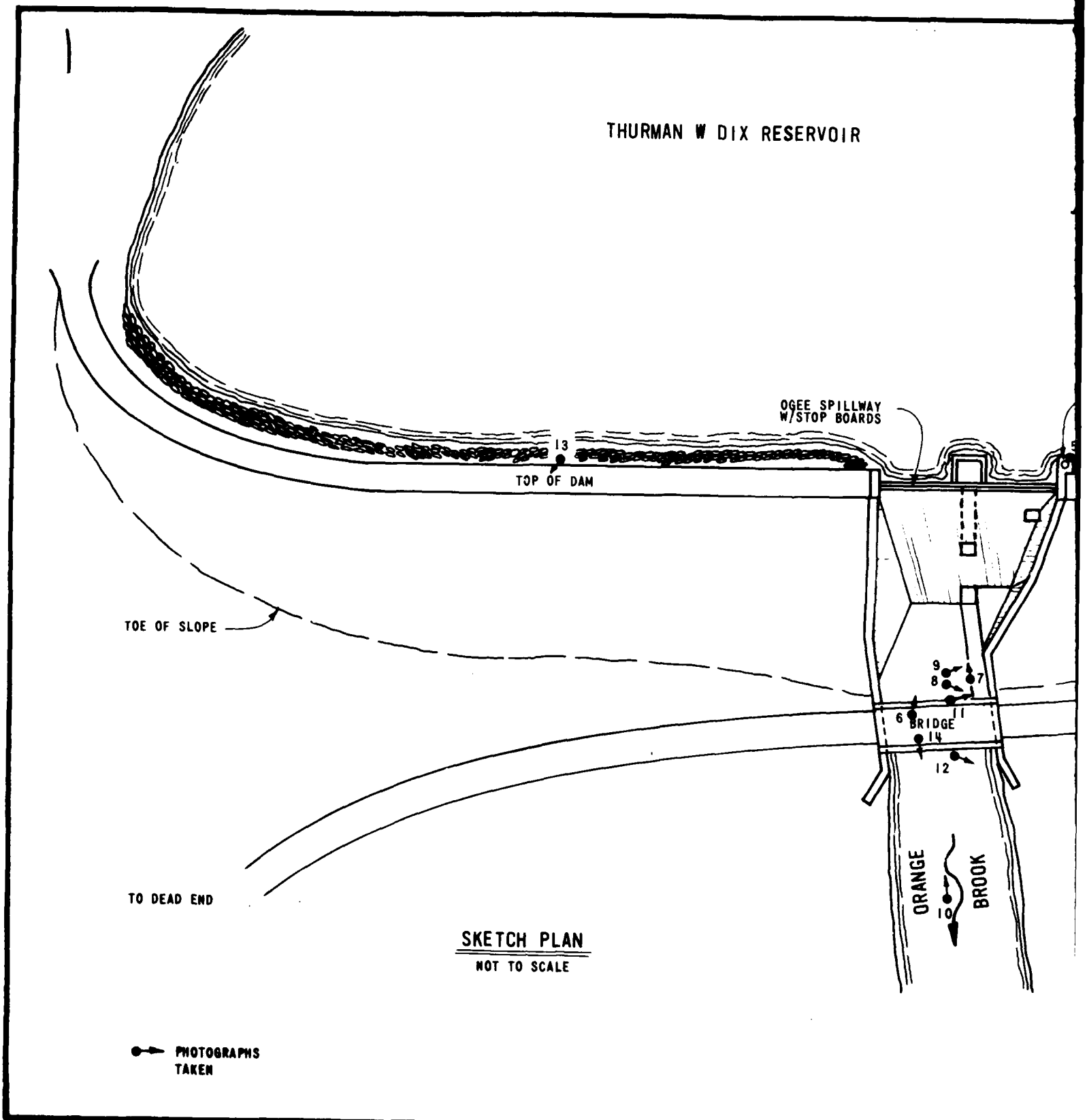
THURMAN DIX RESERVOIR
TOP OF DAM PROFILE

DRAWN BY	RB	9-7-78	SCALE	AS SHOWN
ENG.	MRP		DATE	9-7-78

APPENDIX C

PHOTOGRAPHS

1. Monument dedicating and renaming reservoir in honor of Thurman W. Dix.
2. View of upstream face of dam from access parking area to right abutment.
3. View of downstream face of dam from toe at left abutment contact.
4. Upstream view of spillway with flashboards in place.
5. Close-up of crack and misalignment in upstream face of left spillway abutment wall.
6. View of spillway from town road bridge. Note efflorescence on training wall.
7. Exposed reinforcing rods in floor of bottom outlet channel.
8. Crack and spalling of concrete near joint at left training wall bridge abutment.
9. Exposed reinforcing rods and spalled concrete on left training wall.
10. Spalled concrete on left training wall with seep under pressure.
11. View of bridge looking upstream towards spillway
12. Left bridge abutment poor bond at ledge concrete interface, some minor seep. Note efflorescence.
13. Indication of voids as a result of settlement of earth fill.
14. View of discharge channel looking downstream.


THURMAN W DIX RESERVOIR
OGEE SPILLWAY
W/STOP BOARDS
13
TOP OF DAM
TOE OF SLOPE
9
8
7
6
BRIDGE
14
11
12
TO DEAD END
ORANGE
BROOK
10
SKETCH PLAN
NOT TO SCALE
PHOTOGRAPHS
TAKEN

DUFRESNE-HENRY ENGINEERING CORPORATION

BY E. J. Slavin SUBJECT T. W. Dix Reservoir SHEET NO. 3A OF 6A
DATE 10/02/78 Rating Curve for Top of Dam JOB NO. 22-0559

All calculations are based on the assumption that the dam represents a broad crested weir, 15' across crest.

$$Q = CAH_{max}^{1/2}$$

Lake Elevation Ft. Above MSL	Weir Length L (in feet)	Area A (sq. Ft.)	Head (max)	C	Q (CFS)
1290	0	0	0	----	0
1290.5	793	375	0.7	2.7	850
1291	816	785	1.2	2.63	2260
1291.5	833	1200	1.7	2.63	4115
1292	851	1620	2.2	2.63	6320
1292.5	861	2050	2.7	2.63	8860
1293	861	2480	3.2	2.63	11670

DUFRESNE-HENRY ENGINEERING CORPORATION

BY E. J. Slavin
DATE 10/02/78

SUBJECT T. W. Dix Reservoir
Rating Curve for Overflow Spillway

SHEET NO. 2A OF 6A
JOB NO. 22-0559

Discharge on Overflow Spillway

(Calculations are based on the assumption that all three feet of flash board are in place and that the supports will not fail during flood flow.)

$$Q = CLH^{3/2} \quad \text{(Francis Formula)}$$

Lake Elevation in Feet Above MSL	Weir Length (L) in Feet	Head (H) in Feet	C	Q (in CFS)
1283	77	0	3.33	0
1284	77	1	3.33	255
1285	77	2	3.33	725
1286	77	3	3.33	1330
1287	77	4	3.33	2050
1288	77	5	3.33	2877
1289	77	6	3.33	3770
1290	77	7	3.33	4750
1290.5	77	7.5	3.33	5265
1291	77	8	3.33	5800
1291.5	77	8.5	3.33	6355
1292	77	9	3.33	6920
1292.5	77	9.5	3.33	7510
1293	77	10.0	3.33	8110

DUFRESNE-HENRY ENGINEERING CORPORATION

E. J. Slavin
DATE

SUBJECT Thurman Dix Reservoir
Rating Curve for Drawdown Structure

SHEET NO. 1A OF 6A
JOB NO. 22-0559

Discharge from Drawdown Structure

NOTE: Three possible structures exist which might be opened to allow drawdown. However, two of these structures could not be opened during a flood as they require the operator to be on the dam crest. Also, to the best knowledge of the City Engineer these two gates have never been opened nor does he nor anyone else know how to operate them. Thus, only the accessible structure was included in the analysis.

Structure is a 4 x 4 concrete box conduit. Because the exit of the conduit is located in the dam face well above the base of the dam, inlet control was assumed.

Lake Elevation (Feet Above MSL)	HW/D	Q/B	Q in CFS
1280	2.5	45	180
1281	2.75	47	188
1282	3.0	50	200
1283	3.25	--	---
1284	3.5	54	216
1285	3.75	--	---
1286	4.00	57	228
1287	4.25	--	---
1288	4.5	60	240
1289	4.75	--	---
1290	5.0	64	256
1291	5.25	65	260
1292	5.5	67	268
1293	5.75	68	272

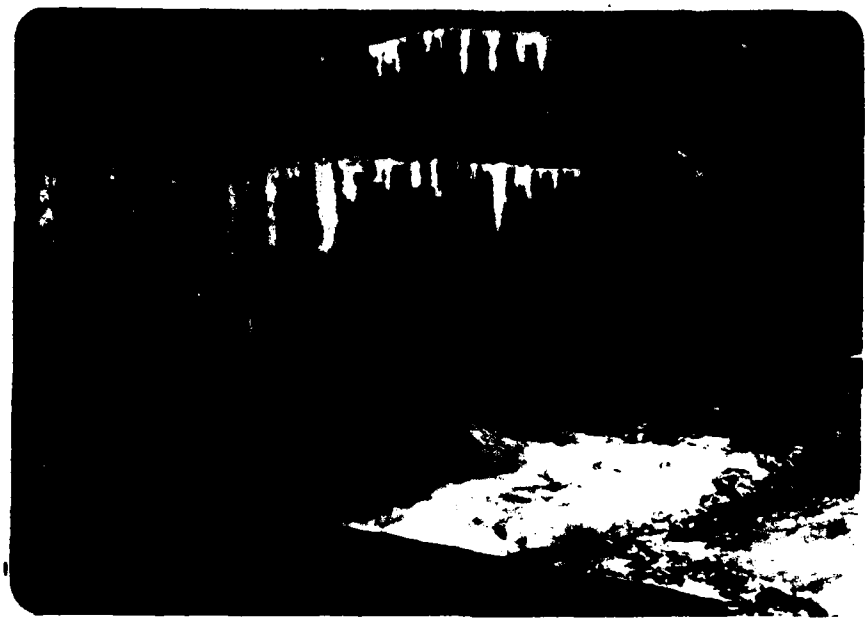
(All calculations based on the assumption of inlet control. All calculations according to the guidelines as set forth in the U. S. Dept of Commerce Hydraulic Engineering Circular No. 5.)

ANALYSIS WITH FLASHBOARDS

APPENDIX D

Hydraulic Computations

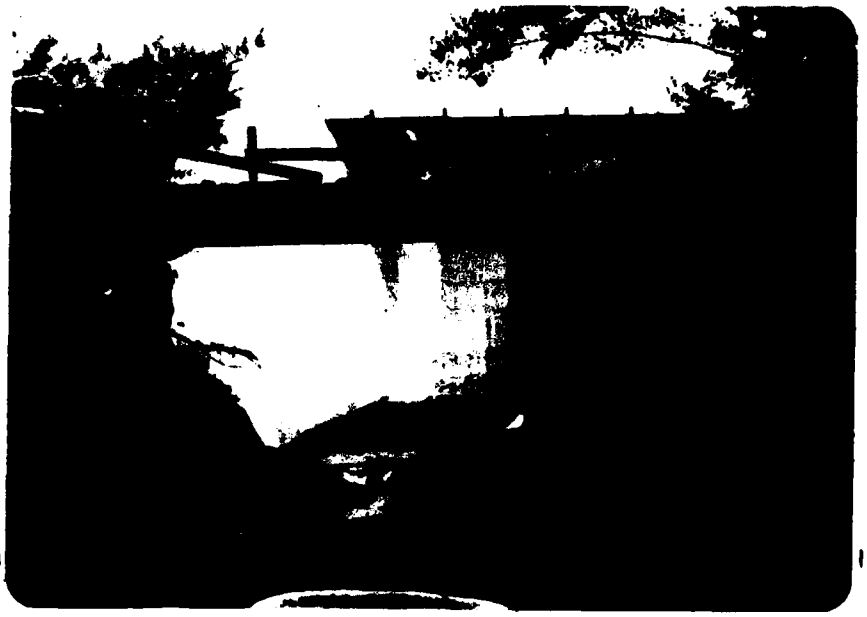
#14 VIEW OF DISCHARGE CHANNEL LOOKING DOWNSTREAM



#12 LEFT BRIDGE ABUTMENT POOR BOND AT LEDGE CONCRETE INTERFACE, SOME MINOR SEEP. NOTE EFFLORESCENCE.

#13 INDICATION OF VOIDS AS A RESULT OF SETTLEMENT OF EARTH FILL

#10 SPALLED CONCRETE ON LEFT TRAINING WALL WITH SEEP UNDER PRESSURE

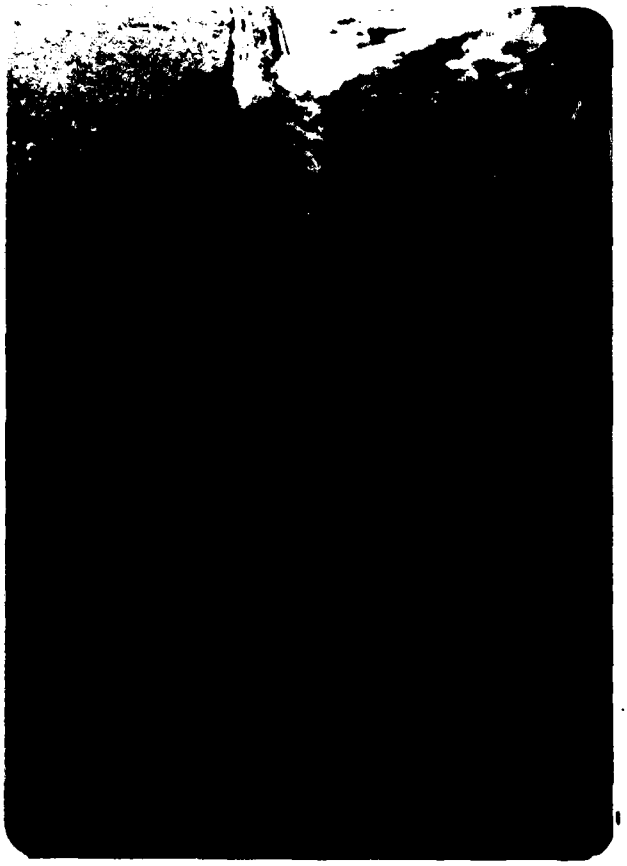


#11 VIEW OF BRIDGE LOOKING UPSTREAM TOWARDS SPILLWAY

#8 CRACK AND SPALLING OF CONCRETE NEAR JOINT AT LEFT TRAINING WALL BRIDGE ABUTMENT

#9 EXPOSED REINFORCING RODS AND SPALLED CONCRETE ON LEFT TRAINING WALL

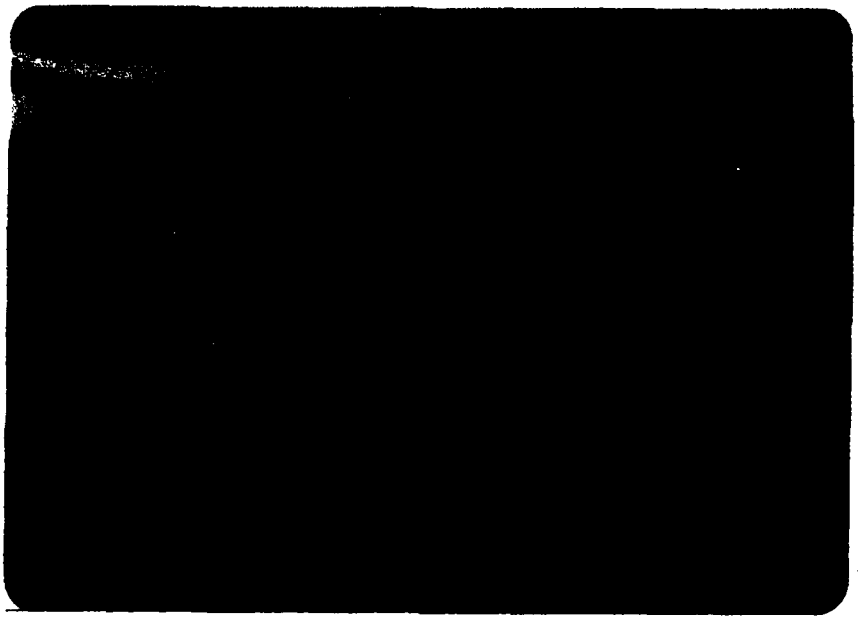
#6 VIEW OF SPILLWAY FROM TOWN ROAD BRIDGE. NOTE EFFLORESCENCE ON TRAINING WALL



#7 EXPOSED REINFORCING RODS IN FLOOR OF BOTTOM OUTLET CHANNEL

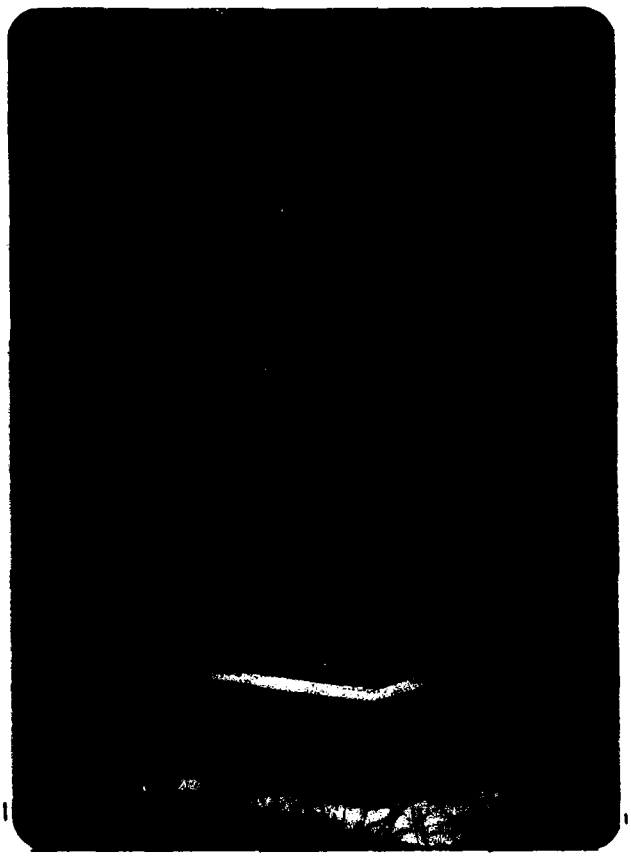
#4 UPSTREAM VIEW OF SPILLWAY WITH FLASHBOARDS IN PLACE

#5 CLOSE-UP OF CRACK AND MISALIGNMENT IN UPSTREAM FACE OF LEFT SPILLWAY ABUTMENT WALL



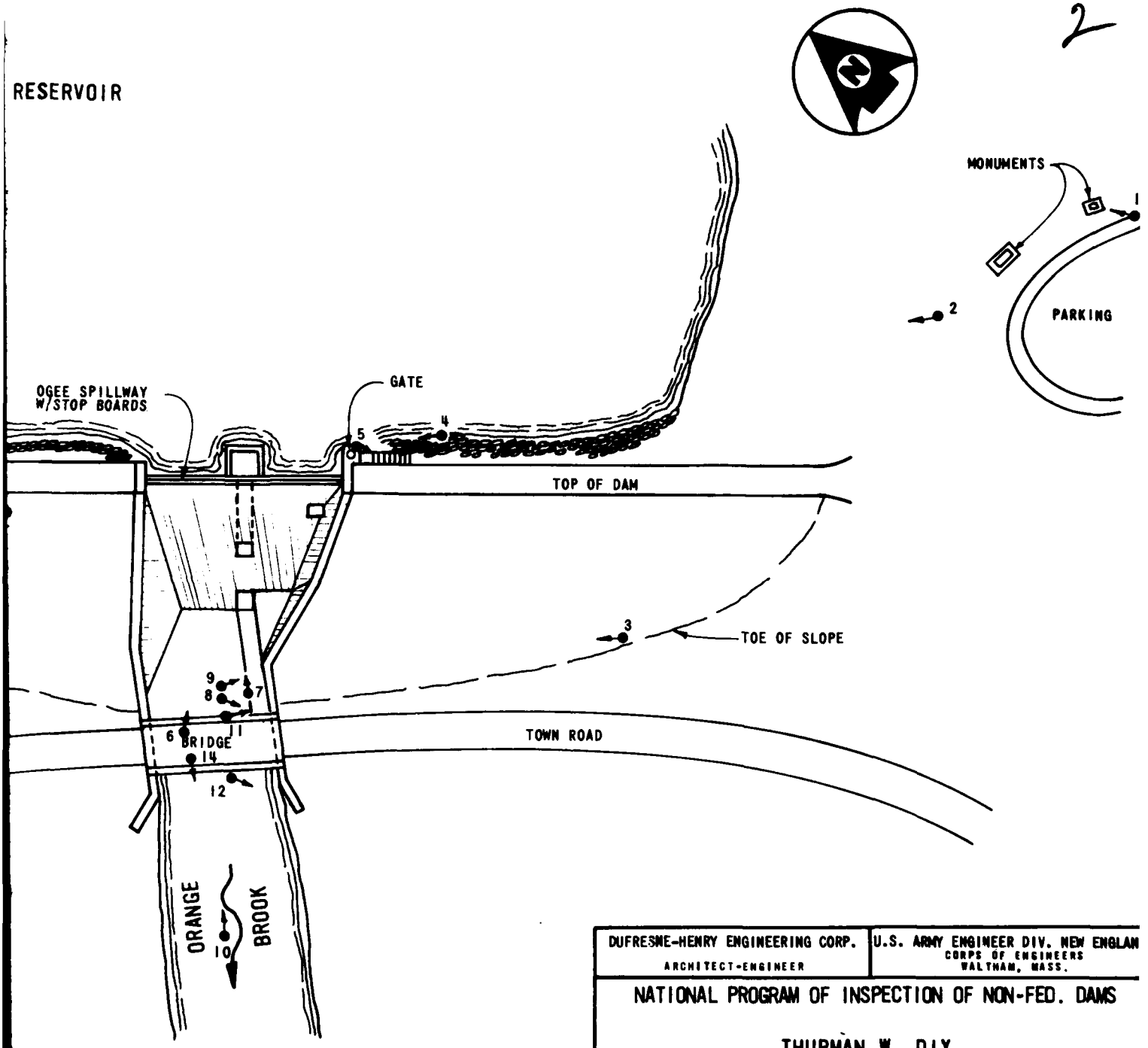
#2 VIEW OF UPSTREAM FACE OF DAM FROM ACCESS PARKING AREA TO RIGHT ABUTMENT

#3 VIEW OF DOWNSTREAM FACE OF DAM FROM TOE AT LEFT ABUTMENT CONTACT



#1 MONUMENT DEDICATING AND RENAMING
RESERVOIR IN HONOR OF THURMAN W. DIX

2



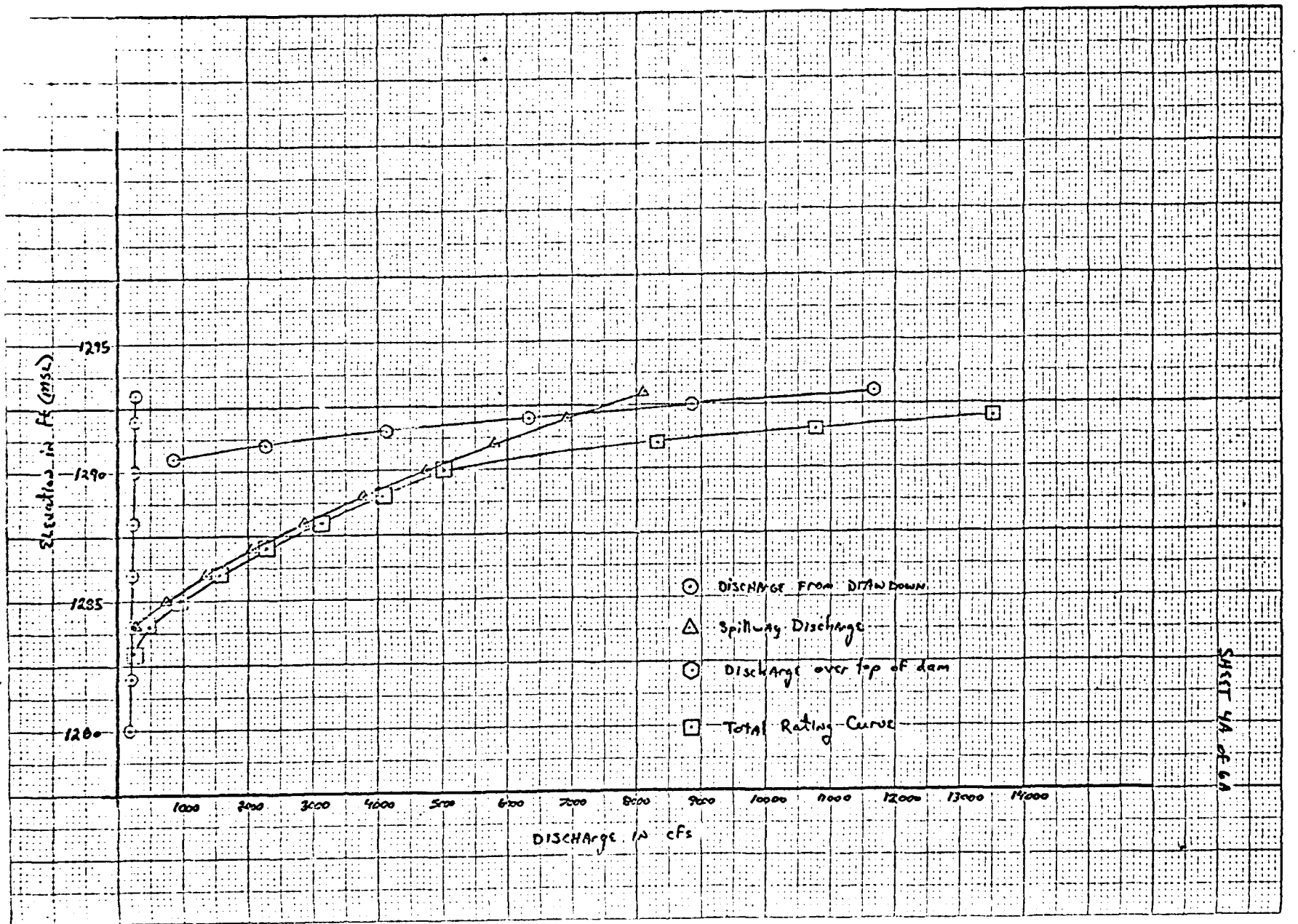
DUFRESNE-HENRY ENGINEERING CORP. ARCHITECT-ENGINEER	U.S. ARMY ENGINEER DIV. NEW ENGLAN CORPS OF ENGINEERS WALTHAM, MASS.

NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

THURMAN W. DIX
RESERVOIR DAM

ORANGE VERMONT

DRAWN BY	RB	9-11-78	SCALE NTS
ENGR.	MRP	9-11-78	DATE SEPT. 11, 1978


Elevation in Ft (MSL)
1295
1290
1285
1280
1000
2000
3000
4000
5000
6000
7000
8000
9000
10000
11000
12000
13000
14000
DISCHARGE IN CFS
DISCHARGE FROM DRAWDOWN
Spillway Discharge
Discharge over top of dam
Total Rating Curve
SHEET 4A OF 6A

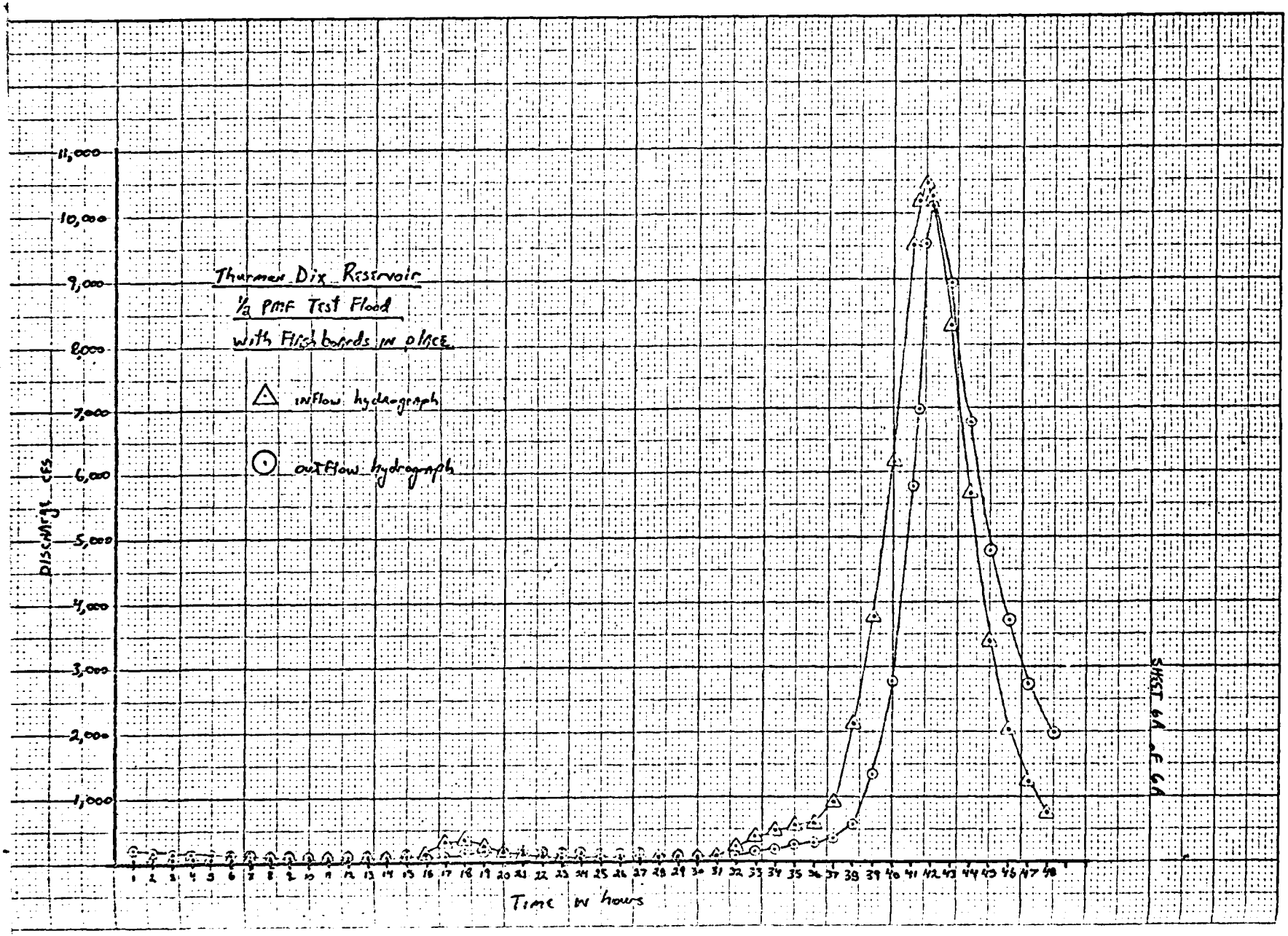
DUFRESNE-HENRY ENGINEERING CORPORATION

BY E. J. Slavin SUBJECT Thurman Dix Reservoir SHEET NO. 5A OF 6A

DATE 10/5/78 Composite Rating Curve JOB NO. 22-0559

Composite Rating Curve for Dix Reservoir

Lake Elevation in Feet Above MSL	Discharge in CFS
1283	210
1284	470
1285	950
1286	1560
1287	2280
1288	3120
1289	4020
1289.8	4315
1290	5005
1291	8320
1291.5	10735
1292	13508


Thurmen Dix Reservoir
½ PMF Test Flood
With Flashboards in place
inflow hydrograph
outflow hydrograph
Discharge CFS
11,000
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
Time in hours
SHEET 64 OF 64

ANALYSIS WITHOUT FLASHBOARDS

DUFRESNE-HENRY ENGINEERING CORPORATION

BY E. J. Slavin SUBJECT Thurman Dix Reservoir SHEET NO. 1 OF 6
DATE Rating Curve for Drawdown Structure JOB NO. 22-0559

Discharge from Drawdown Structure

NOTE: Three possible structures exist which might be opened to allow drawdown. However, two of these structures could not be opened during a flood as they require the operator to be on the dam crest. Also, to the best knowledge of the City Engineer these two gates have never been opened nor does he nor anyone else know how to operate them. Thus, only the accessible structure was included in the analysis.

Structure is a 4 x 4 concrete box conduit. Because the exit of the conduit is located in the dam face well above the base of the dam, inlet control was assumed.

Lake Elevation (Feet Above MSL)	HW/D	Q/B	Q in CFS
1280	2.5	45	180
1281	2.75	47	188
1282	3.0	50	200
1283	3.25	--	---
1284	3.5	54	216
1285	3.75	--	---
1286	4.00	57	228
1287	4.25	--	---
1288	4.5	60	240
1289	4.75	--	---
1290	5.0	64	256
1291	5.25	65	260

(All calculations based on the assumption of inlet control. All calculations according to the guidelines as set forth in the U. S. Dept of Commerce Hydraulic Engineering Circular No. 5.)

Discharge on Overflow Spillway

(Assumption is that flashboards are not in place or will fuction properly.)

$$Q = CLH^{3/2}$$

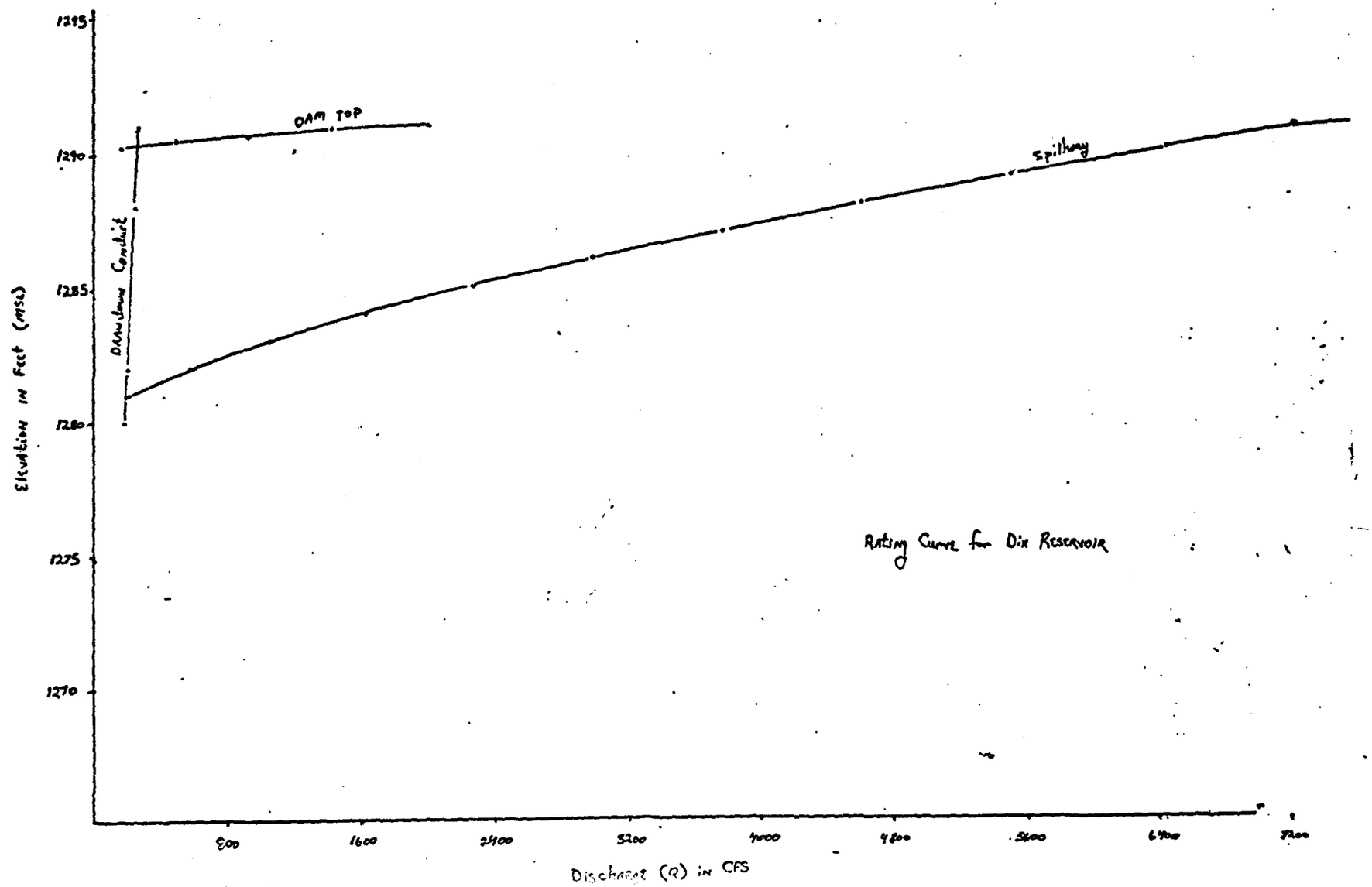
Lake Elevation in Feet Above MSL	Weir Length (L) in Feet	Head (H) in Feet	C	Q (in CFS)
1280	77	0	----	0
1281	77	1.0	2.68	205
1281.6	77	1.6	2.67	415
1282	77	2.0	2.64	575
1282.5	77	2.5	2.64	805
1283	77	3.0	2.64	1055
1283.5	77	3.5	2.64	1330
1284	77	4.0	2.64	1626
1284.5	77	4.5	2.64	1940
1285	77	5.0	2.64	2270
1285.5	77	5.5	2.64	2620
1286	77	6.0	2.64	2990
1286.5	77	6.5	2.64	3370
1287	77	7.0	2.64	3765
1287.5	77	7.5	2.64	4175
1288	77	8.0	2.64	4600
1280.5	77	8.5	2.64	5040
1289	77	9.0	2.64	5490
1289.5	77	9.5	2.64	5950
1290	77	10.0	2.64	6430
1290.2	77	10.2	2.64	6620
1290.4	77	10.4	2.64	6820
1290.6	77	10.6	2.64	7015
1290.8	77	10.8	2.64	7215
1291	77	11	2.64	7415

DUFRESNE-HENRY ENGINEERING CORPORATION

BY E. J. Slavin SUBJECT Thurman Dix Reservoir SHEET NO. 3 OF 6
DATE 08/08/78 Rating Curve for Top of Dam JOB NO. 22-0559

All calculations are based on the assumption that the dam represents a broad crested weir, 15' across crest.

Lake Elevation Ft. Above MSL	Weir Length L (in feet)	Area A (sq. ft.)	Head	C	Q (CFS)
1290	0	0	0	----	0
1290.2	761	139.4	0.18	2.68	160
1290.4	787	294.2	0.37	2.70	485
1290.6	801	453	0.57	2.70	920
1290.8	811	614.2	0.76	2.64	1410
1291	816	776.9	0.95	2.63	1995



Rating Curve for Dix Reservoir

DUFRESNE-HENRY ENGINEERING CORPORATION

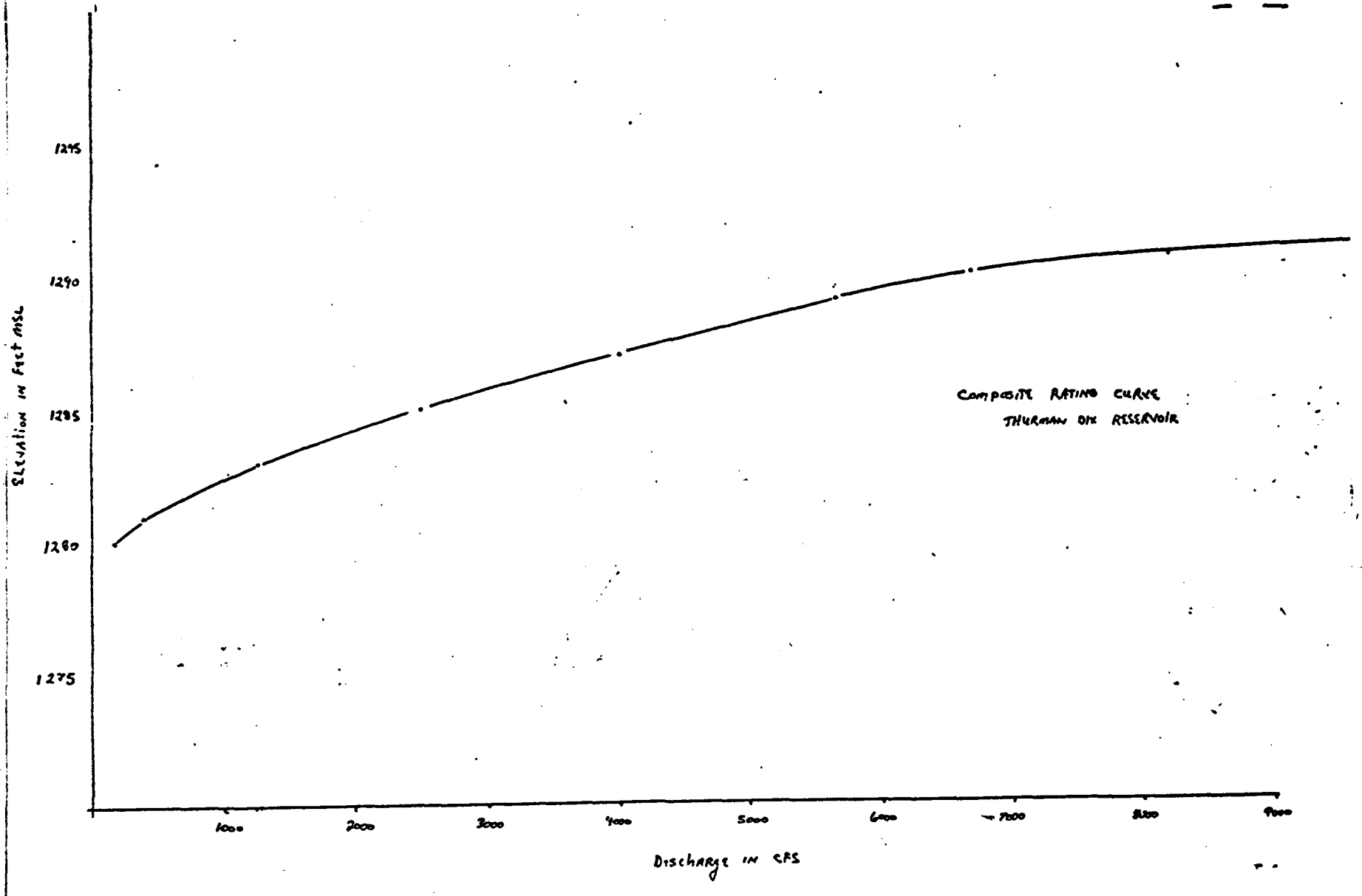
BY E. J. Slavin
DATE 08/08/78

SUBJECT Thurman Dix Reservoir
Composite Rating Curve

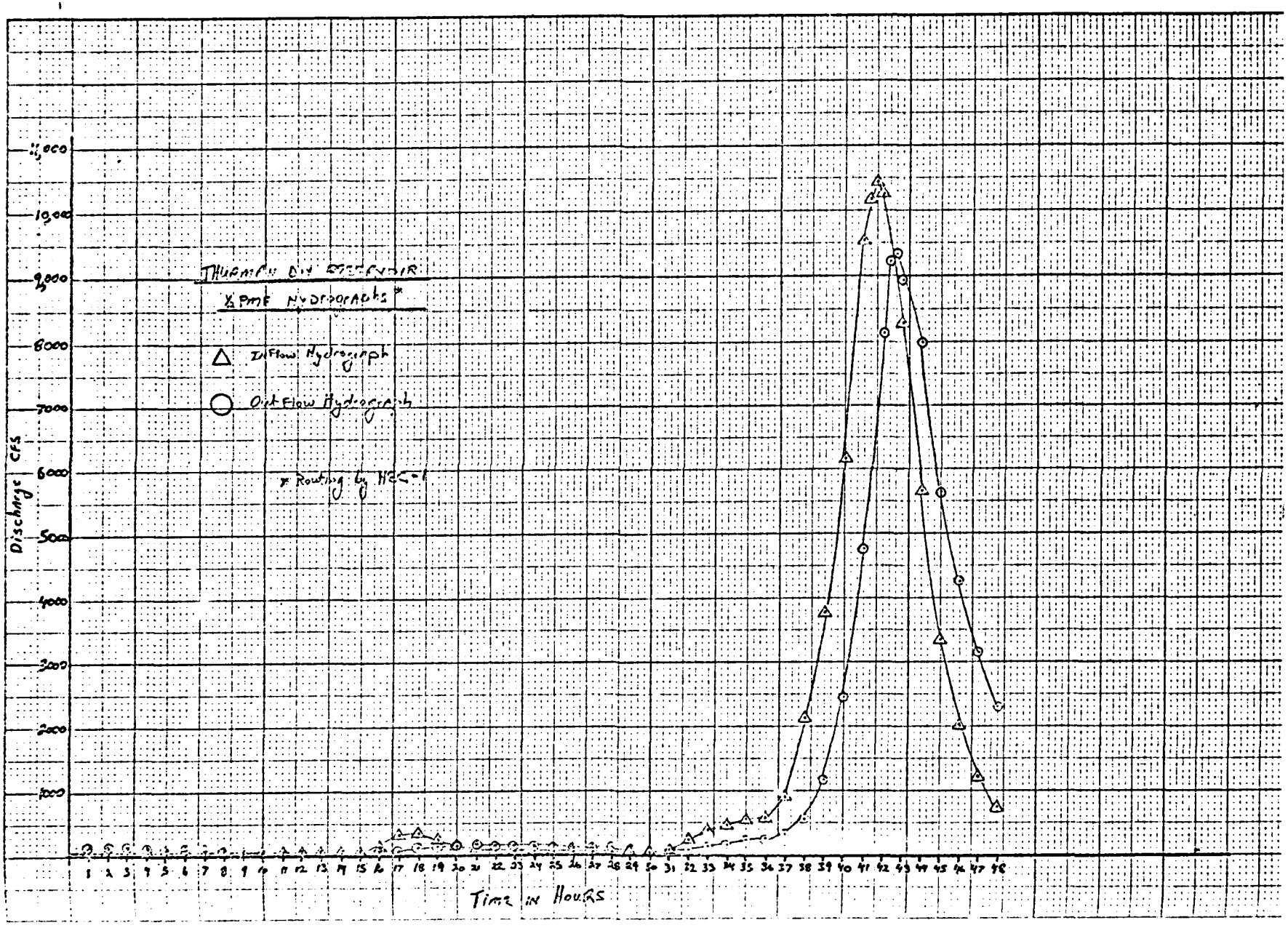
SHEET NO. 5 OF 6
JOB NO. 22-0559

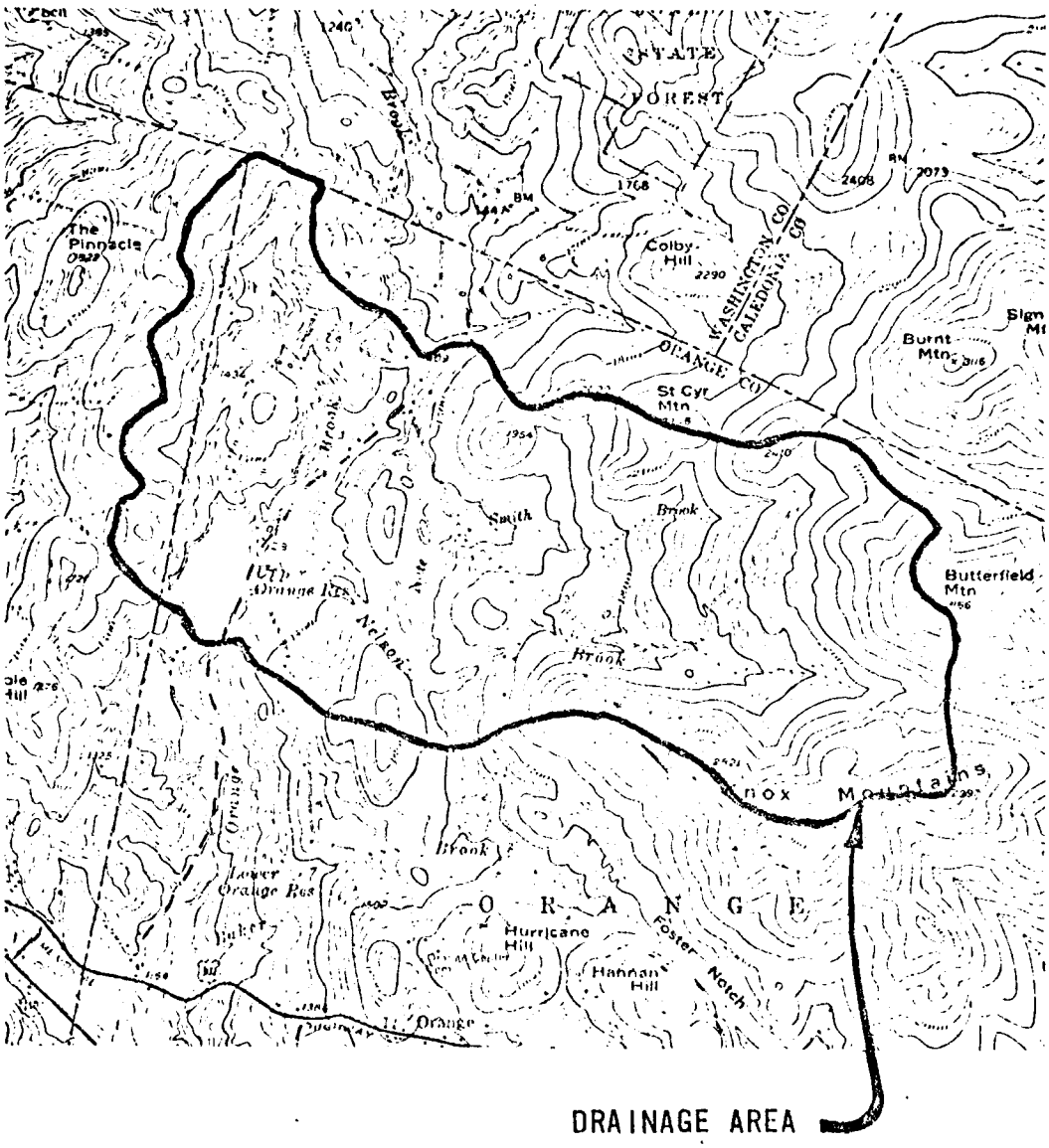
Composite Rating Curve for Dix Reservoir

Lake Elevation in Feet Above MSL	Discharge in CFS
1280	180
1281	395
1283	1265
1285	2490
1287	4000
1289	5740
1290	6685
1290.6	8195
1291	9670



Composite RATING CURVE
THURMAN DAM RESERVOIR


THURMAN DAM EMERGENCY
½ PMF Hydrographs*
Inflow Hydrograph
Outflow Hydrograph
* Routing by HEC-1
Discharge CFS
11000
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48
Time in Hours



MAP SOURCE:

U.S. GEOLOGICAL SURVEY
EAST BARRE QUADRANGLE
VERMONT
15 MIN SERIES
1:62500 1957

CLIENT NO	22-0559	DUPRESNE-HENRY ENGINEERING CORP.	
PROJ ENG	MRP	DRAINAGE AREA	
DRAWN BY	RB	THURMAN W DIX RESERVOIR	
DATE	9-6-78	ORANGE VERMONT	A 6036

APPENDIX E

Information as Contained in the National Inventory of Dams

INVENTORY OF DAMS IN THE UNITED STATES

STATE	IDENTITY NUMBER	DIVISION	STATE	COUNTY	CONGR DIST.	STATE	COUNTY	CONGR DIST.	NAME	LATITUDE (NORTH)	LONGITUDE (WEST)	REPORT DATE DAY | MO | YR
VT	69	NED	VT	011	01				THURMAN W. DIX RESERVOIR DAM	4410.9	7225.5	31JUL78

POPULAR NAME	NAME OF IMPOUNDMENT
	THURMAN W. DIX RESERVOIR

REGION	BASIN	RIVER OR STREAM	NEAREST DOWNSTREAM CITY–TOWN–VILLAGE	DIST FROM DAM (MI.)	POPULATION
01	02	ORANGE BROOK	EAST BARRE	2	500

TYPE OF DAM	YEAR COMPLETED	PURPOSES	STRUCTURAL HEIGHT (FT.)	HYDRAULIC HEIGHT (FT.)	IMPOUNDING CAPACITIES MAXIMUM (ACRE-FT.)	IMPOUNDING CAPACITIES NORMAL (ACRE-FT.)	DIST	OWN	FED R	PRV/FED	SCS A	VER/DATE
HEGTPG	1950		50	40	2280	1070	NED	N	N	N	N	30CT78

REMARKS

DIS HAS	SPILLWAY CREST LENGTH	SPILLWAY TYPE	SPILLWAY WIDTH (FT.)	MAXIMUM DISCHARGE (FT.)	VOLUME OF DAM (CY)	POWER CAPACITY INSTALLED (MW)	POWER CAPACITY PROPOSED (MW)	NAVIGATION LOCKS NO.	LENGTH (FT.)	WIDTH (FT.)	LENGTH (FT.)	WIDTH (FT.)	LENGTH (FT.)	WIDTH (FT.)	LENGTH (FT.)	WIDTH (FT.)
S	920	U	77	6430	170											

OWNER	ENGINEERING BY	CONSTRUCTION BY
CITY OF BARRE	THURMAN W. DIX	

REGULATORY AGENCY			
DESIGN	CONSTRUCTION	OPERATION	MAINTENANCE
WATER RESOURCES BD	WATER RESOURCES BD	WATER RESOURCES BD	WATER RESOURCES BD

INSPECTION BY	INSPECTION DATE DAY | MO | YR	AUTHORITY FOR INSPECTION
DUFRESNE-HENRY ENG CORP	31JUL78	P L 92-367

REMARKS